JUN 16 19

Telephone Engineer

VOL. 31, No. 6 CHICAGO

STROWGER AUTOMATIC

Economy of Maintenance

THE simplicity and sturdiness of Strowger design is especially appreciated by those who are responsible for keeping Strowger switches in perfect condition at all times.

The close contact maintained by Strowger engineers with actual operating conditions has given them a profound appreciation of maintenance problems, which, in turn, is reflected in the Strowger equipment of today.

Strowger design lends itself readily to routine testing whereby trouble is largely forestalled. What few adjustments are necessary are easily and quickly made, and the training of the few necessary employes for this work is a surprisingly easy matter.

Automatic Electric Inc.

Factory and General Offices: 1033 West Van Buren St.
Chicago, U. S. A.

TELEPHONE EQUIPMENT

JUNE, 1927

They are Still Standing up in KANSAS

THE RECENT cyclone which swept through Kansas and the Middle West was most severe—taking a large toll of life and property. The pictures reproduced above show how "Black Beauty" Poles in the lines of the United Power & Light Corporation, near Hutchinson, Kansas, resisted the storm.

Wires were blown off, and note the dangling transformer which was literally blown from the pole—*but the poles themselves stood up and did not break*—although the tremendous wind pressure forced some of them away from the perpendicular, due to the comparatively recent installation and lack of compactness of the surrounding soil.

"Black Beauty" Poles reduce service interruptions and losses from storms to the minimum. They stand up when untreated poles go down.

TEXAS CREOSOTING COMPANY
Main Office and Plant: Orange, Texas, U. S. A.

American Electric Company, Inc.

Distributors of "Black Beauty" Poles to the Independent Telephone Trade.

State & 64th Streets, Chicago, Ill.

2T7

Service with a Capital "S"

Service is a much abused word, but the "Black Beauty" Organization really makes good when put to the test. Here is an example

At 6:10 P. M., May 9th, we received a telegram from the Union Electric Company, of Abilene, Kansas, ordering immediate shipment of 3 cars of "Black Beauty" Poles to the United Power & Light Corporation, at Hutchinson, Kan., to replace storm losses of untreated poles. The 3 cars were loaded that same night with select poles from our large stock which we carry treated to standard specifications. At 8:25 A. M., the following morning, we wired them the car numbers and routing and the cars left our plant at 9 A. M.—less than 15 hours after the order was received.

"Black Beauty" Poles

TELEPHONE ENGINEER, June, 1927. Volume 31. No. 6. Published monthly by TELEPHONE ENGINEER. Publication Office, 236 N. Clark St., Chicago, Ill. Subscription price $2 a year in the U. S. Entered as second class matter June 6, 1922, at the Post Office at Chicago, Ill., under act of March 3, 1879.

Telephone Engineer

Volume 31 JUNE, 1927 Number 6

Avoid "Eleventh Hour" Depreciation Studies

It is with considerable relief that telephone companies have received the order of the Interstate Commerce Commission deferring the date of filing data on depreciation to March 1, 1928, and the date of putting the order into effect to Jan. 1, 1929. This will give more time to study the possible effect of the changes and to ask for modifications in places where the compliance with the order seems to be impracticable. It will also give individual companies more time to study their past history and to secure more reliable data to present.

There is danger that the delay, however, will only mean further delay on the part of some companies in starting the study. In our earlier days as a pedagog we once assigned a problem that required a trip to a certain location to gather data. In order to allow sufficient time, we allowed one week to hand in the solution. It happened that we passed near the place where the data were to be obtained on the night before the problem was due and found the entire class there with one exception. A time allowance of a week to hand in the problem meant a time allowance of six days before starting. We may add that the member of the class who was not present failed entirely to hand in the solution.

The time to start to meet the requirements of the depreciation order is now. Every company can check up on its plant accounting methods to see that proper charges and credits are made when plant is constructed or removed. If it does not have its plant account broken down into the accounts prescribed in the accounting system, it can arrange for the necessary inventories. If it has data from which life cycle studies can be made, these studies can be started. An early start in these things will permit more time for consideration of results and more accurate figures when the final report is filed.

No Magic in the Merging of Many Companies

One of the favorite forms of propaganda in the present activity in the purchase and consolidation of telephone properties is that grouping into larger units is an economic necessity; that the only salvation of the smaller units is to group them into companies of 10,000 stations and upwards. The only weak spot in the argument is that it is not the entire truth as hundreds of successful systems ranging from 100 or so stations to several thousand will bear witness.

There are many weak units still operating in the telephone field that will profit by consolidation under proper management. Most of these units are those that by reason of poor management or inadequate finances have been unable to make the improvements in plant and service that the modern age demands or have not been able to secure rates which will yield an adequate return on the investment.

On the other hand the mere tying together into one company or the acquisition by one holding company of a large number of small isolated units does not guarantee successful operation of the individual units nor satisfactory financial results of the consolidated system. The element of management must be present and the management must be in the hands of telephone men of experience with smaller systems.

If consolidation of small units into large groups is economically sound, the question arises as to why the Bell operating companies find so many of their small exchanges in the red year after year.

The real fact of the situation is that success in telephone operation has no relation to the size of the system, but is controlled by other factors. If those who are working out the grouping of small properties can finance them adequately and conservatively, can give a quality of service which will satisfy the public and can collect a rate that will provide a fair return on the investment, the consolidation will be a success. If it can not do these

things, the consolidation will be a failure regardless of its size or of the character of the units that make it up.

Architects' Education Still a Big Field

The other day we were talking to a telephone installer about some rather difficult angles of the job he was working on and we complimented him on the neat and workmanlike manner in which he did the wiring and placed the instrument. His reply, made with all the pride of craftmanship, was that he did not mind the hard jobs if the finished work gave that satisfaction which comes from a good job well done. Of course, these were not his exact words; what he actually said was, "I don't mind the tough jobs if they look all right when I get them done."

We then listened to him for a while, for, like all good workmen when they find a sympathetic listener, he was anxious to talk about his work. We gathered a very definite impression of his opinions of architects and builders and householders who design and build and complete and move into fine, new residences without making any provision whatever for the telephone installation. He told us of one house costing many thousands of dollars in which he had been compelled to do an exposed job of wiring in an unsightly way, when a little forethought would have provided the wiring while the house was under construction.

One ray of hope existed for him, however, for he said that he was finding some of the newer houses provided with a place for the telephone and means for concealing the wiring. Apparently some architects and builders have come to recognize the need of such provision, although the space provided was not always large enough or conveniently located.

Our conversation with this man who is doing his bit by installing our telephones, led us to ponder over the situation and to wonder what might be done to educate the architect and the building contractor. They know that telephones must be installed but they leave the job entirely to the telephone company. They seem to regard the telephone as part of the furnishings which is to be moved-in with the other household goods, rather than as a permanent part of the building like the electric fixtures and the gas range. Who can suggest a way to get them to view the matter in a different light?

Careless Drivers Take Toll of Poles

In a recent edition of a metropolitan newspaper was shown a map of a suggested Sunday auto tour which was drawn with the artist's imagination of the pictures to be seen on the road, something after the style of the ancient cartographers. One of the sketches was of particular interest to telephone men. An auto was shown in violent contact with a telephone pole and the legend read, "There are many telephone poles along the Dixie Highway, but no telephone pole ever struck an automobile except in self-defense."

In these days of high speed travel and careless driving the unfortunate telephone pole is often in the same position as the innocent bystander at a free-for-all scrap. Indeed, the pole is less frequently guilty of contributory negligence than the bystander, for it is firmly set in five or more feet of earth and has no alternative but to stand and take the blow.

Our guess is that, in spite of the immobility of the pole, the honors of combat between poles and autos is about fifty-fifty. Our sympathy for the non-aggressor makes us wish that the pole might always be the victor, but there seems little possibility that this will ever occur. On the theory that the one who causes the damage should foot the bill, the auto owner should be required to stand whatever damages that are caused by his carelessness. While compulsory auto-insurance may not be desirable from every angle, it might at least have the advantage of assuring telephone companies of compensation in cases of damage to their lines due to careless driving.

Farm Field Is Far From Saturation

Statistics of the telephone industry in the last few years indicate that growth in subscriber stations is due almost entirely to the cities and that the number of telephones in small towns and on the farms is practically stationary. This condition is a result of the long-continued depression in agricultural areas rather than of the fact that saturation has been reached in these areas.

There are still almost one-third of the farms of the country without telephone service and until a part or all of these have been supplied, we will not have saturation. It can not be assumed that there will be no further growth in rural areas in the future as long as there are farms without telephones. Experience in certain localities where there has been some improvement in farm conditions has indicated that improvement will be followed by renewed demand for service.

Many companies have been reluctant to rebuild or extend farm lines due, in part, to lack of prospective demand for new service and, in part, to inadequate return on the lines now in service. The question arises as to what these companies will do when conditions improve and the demand for service renews. Other companies have taken a more enlightened view and as far as they have been able, have rebuilt and regrouped their farm lines so that the demand will not find them unprepared.

Compound Interest and Depreciation Formulae*

By F. J. DOMMERQUE
Fellow A. I. E. E.

66. Exponential Equations

The application of logarithms opens entirely new fields of mathematical exploitation, one of them being the field of exponential equations. An exponential equation is one in which the unknown quantity x occurs in the exponent. The general form of a simple exponential equation would be written $a^x = b$. Let us take an example.

Given $2^x = 3$. What would be the value of x?

Taking the logarithm of both sides of the equation, we have $\log (2^x) = \log 3$, and thus $x \log 2 = \log 3$, whence $x = \frac{\log 3}{\log 2}$. Using tables of logarithms, we find $x = \frac{0.47712}{0.30103} = 1.5850$ by the ordinary process of division. We may also find the value of x by a further application of logarithms, thus: As $x = \frac{\log 3}{\log 2}$, we have then $\log x = \log (\log 3) - \log (\log 2)$; it is—

$\log (\log 3) = \log 0.47712 = 9.67863-10$ ..... $= 0.67863-1$
$\log (\log 2) = \log 0.30103 = 9.47861-10$ ..... $= 0.47861-1$

By subtraction $\log x$ ..... $= 0.20002$

From the table of logarithms the corresponding number is found as $x = 1.5850$.

As interesting as the subject of exponential equation may be, we can not at the present devote more time to them, but will proceed to a practical application of importance in commercial telephony.

67. Compound Interest

Although compound interest is by itself not of particular importance to the telephone man, it gains on importance because it forms the basis for developing a formula for calculating depreciation, with which every telephone exchange manager should be familiar.

Let A be the principal in dollars, which is to be invested at p per cent compound interest for n years in succession, and let the interest be compounded annually without any money being withdrawn during the n years, then, as 100 dollars bring p dollars interest, or one dollar $\frac{p}{100}$ dollar in a year, A dollars will bring $A\frac{p}{100}$ dollars. At the end of the first year the principal A will have grown to $A + \frac{Ap}{100}$ dollars. Let this amount be designated by A_1, then

$$A_1 = A\left(1 + \frac{p}{100}\right).$$

Designating the amount at the end of the 2nd, 3rd.....nth year by A_2, A_3,..... A_n respectively, the principal will have grown at the end of the second year to

$$A_2 = A_1\left(1 + \frac{p}{100}\right) = A\left(1 + \frac{p}{100}\right)\left(1 + \frac{p}{100}\right) = A\left(1 + \frac{p}{100}\right)^2 \text{ dollars,}$$

at the end of the third year to $A_3 = \left(1 + \frac{p}{100}\right)^3$ and so on. At the end of the nth year it will have grown to

$$A_n = A\left(1 + \frac{p}{100}\right)^n \text{ dollars} \quad \ldots\ldots (1)$$

To solve this equation, we take the logarithms of both sides of the equation, thus

$$\log A_n = \log A\left(1 + \frac{p}{100}\right)^n = \log A + n \log \left(1 + \frac{p}{100}\right);$$

and then find the number corresponding to $\log A_n$.

As an example it may be assumed a principal of \$7,654.32 is to remain on compound interest at 6 per cent for 20 years; what will be the amount at the end of the 20th year? Here $A = 7654.32$; $p = 6$ and $n = 20$. Then $\log A_n = \log 7654.32 + 20 \times \log\left(1 + \frac{6}{100}\right) = \log 7654.32 + 20 \times \log 1.06$;

it is $\log 7654.32$ ..... $= 3.883906$
$20 \times \log 1.06 = 20 \times 0.0253059$. $= 0.506118$

by addition $\log A_n$ ..... $= 4.390024$

and the corresponding number is $A_n = 24548.40$, which means \$7,654.32 has grown to \$24,548.40 in 20 years.

Suppose the final amount A_n were given and the initial amount A were to be calculated, the equation

$$A_n = A\left(1 + \frac{p}{100}\right)^n$$

would give the value

$$A = \frac{A_n}{\left(1 + \frac{p}{100}\right)^n} \quad \ldots\ldots (2)$$

Taking the logarithms of both sides, we have

$$\log A = \log A_n - n \log \left(1 + \frac{p}{100}\right)$$

If it should be asked, for example, what sum of money will amount to \$1,234.56 at the end of 3 years at 5 per cent compound interest, we would have by equation (2)

$$A = \frac{1234.56}{\left(1 + \frac{5}{100}\right)^3}; \text{ then}$$

$\log A = \log 1234.56 - 3 \log 1.05$.
It is $\log 1234.56$ ..... $= 3.091512$
and $3 \times \log 1.05 = 3 \times 0.021189$. $= 0.063567$

by subtraction $\log A$ ..... $= 3.027945$

and the corresponding number $A = 1066.46$; thus \$1066.46 is the sum of money which will grow to \$1234.56 in 3 years at 5 per cent compound interest.

If A, A_n and n are given and the percentage p to be found, we know from equation (1) that

$$\left(1 + \frac{p}{100}\right)^n = \frac{A_n}{A};$$

$$\text{then } n \log\left(1 + \frac{p}{100}\right) = \log A_n - \log A$$

$$\text{or } \log\left(1 + \frac{p}{100}\right) = \frac{\log A_n - \log A}{n} \quad \ldots\ldots (3)$$

Finding the number corresponding to this logarithm we obtain the value of $1 + \frac{p}{100}$, from which p can be easily determined.

As an example, an amount of \$500 had grown in 6 years to \$632.65, what would be the rate per cent per annum?

$$\text{It is } \log\left(1 + \frac{p}{100}\right) = \frac{\log A_n - \log A}{n} = \frac{\log 632.65 - \log 500}{n}$$

$\log 632.65$ ..... $= 2.801163$
$\log 500$ ..... $= 2.698970$

by subtraction we obtain..... 0.102193

Dividing this by 6 gives $\log\left(1 + \frac{p}{100}\right) = 0.017033$; the number corresponding is $1.04 = 1 + \frac{p}{100}$, whence $p = 4$ per cent.

*Fifteenth article on Telephone Mathematics and Physics.

In a case where the initial amount A, the final amount A_n and the percentage p are known, and where it is to be found in how many years A will reach the amount A_n at p per cent compound interest, equation (3) will give

$$n = \frac{\log A_n - \log A}{\log\left(1+\frac{p}{100}\right)};$$

then $\log n = \log [\log A_n - \log A] - \log\log\left(1+\frac{p}{100}\right)$ ..... (4)

Example: In what time will $500 at 6 per cent compound interest grow to $750?

Answer: in $n = \frac{\log 750 - \log 500}{\log\left(1+\frac{6}{100}\right)}$ years.

log 750 ..... = 2.870613
log 500 ..... = 2.698970

by subtraction 0.181543

(which is log 750 — log 500); furthermore, log 1.06 = 0.0253059, whence $n = \frac{0.181534}{0.0253059} = 7.1735$ years.

In all the above cases the interest was compounded annually. If the interest is to be compounded semi-annually, the intervals, that is, n would be doubled and the percentage halved; thus equation (1) would then become

$$A_n = A\left(1+\frac{p}{200}\right)^{2n} \text{ ..... (5)}$$

If the interest were compounded monthly the equation (1) would become

$$A_n = A\left(1+\frac{p}{1200}\right)^{12n} \text{ ..... (6)}$$

68. Depreciation Formulae

Depreciation represents the monetary equivalent of the wear and tear of an object, in our case of the telephone plant or any of its component parts. Depreciation and maintenance must be kept apart. Maintenance means to keep the telephone plant in constant operating condition. To this end repairs and minor renewals have to be made. Depreciation, however, means to set aside each year a certain sum of money to replace the telephone plant as a whole or any part of it when it is worn out so that it can not be repaired any more, or when the plant has become obsolete. However, the amount to be set aside has nothing to do with the amount required to bring the plant up to date. When the plant was built originally it had a certain number of subscribers to start with; this number increased continually and outgrew the capacity of the plant; the new plant or that part of it which has to be replaced, must certainly be larger than the original plant it has to replace; that is, it must be arranged for a greater number of subscribers than could be accommodated by the original plant in its ultimate capacity; consequently the amount of money paid for the original plant, that is, its first cost, would not be sufficient to buy the new equipment. Therefore, when we speak of depreciation, we mean that the sum to be set aside each year is to write off the amount or first cost of the original plant and not the amount required to install the new plant or part thereof, which requires new provision for depreciation.

New subscribers coming in continuously, provision must be made from day to day in some parts of the plant to take care of them as they come in. The question arises how to charge properly for depreciation of this new construction. Thus first a distinction has to be made between new construction and maintenance construction, and then it must be fixed, what amount is to be charged for depreciation each year, or whatever period the telephone company chooses for this purpose.

The U. S. Independent Telephone Association has issued a booklet on the "Uniform System of Accounting for Fixed Capital, Maintenance and Depreciation" which defines the dividing line between items of a telephone plant which should be charged to depreciation and items which should be charged to maintenance. It furthermore classifies the plant units, all of which is essential for the determination whether a replacement shall be charged to maintenance, or to construction and depreciation.

We recommend to the reader the study of this booklet, as it is not in our province to discuss operating matters but to develop formulas; that is, ways and means whereby the depreciation amount to be set aside is to be calculated.

To find the annual depreciation charge "b" which, when invested at p per cent must be set aside each year, if "n" years is the term of useful life of the plant or plant unit to be depreciated, let the investment, or first cost of plant or plant unit to be depreciated, equal "A" dollars. At the end of the first year the amount b payable can be invested again at p per cent for n — 1 years, hence the original amount b will grow to

$$b\left(1+\frac{p}{100}\right)^{n-1};$$

at the end of the second year another amount b will be payable and can be invested for n — 2 years, hence will grow to $\left(1+\frac{p}{100}\right)^{n-2}$; and so on. The amount b payable at the end of the nth year will not change. The sum of all these amounts b must equal the investment A. Thus

$$b\left(1+\frac{p}{100}\right)^{n-1} + b\left(1+\frac{p}{100}\right)^{n-2} + \ldots\ldots + b = A;$$ to determine b we arrange the terms of this equation in reversed order, thus

$$A = b + b\left(1+\frac{p}{100}\right) + b\left(1+\frac{p}{100}\right)^{2} + \ldots\ldots + b\left(1+\frac{p}{100}\right)^{n-2} + b\left(1+\frac{p}{100}\right)^{n-1};$$ then we multiply each term by $\left(1+\frac{p}{100}\right)$ obtaining

$$A\left(1+\frac{p}{100}\right) = b\left(1+\frac{p}{100}\right) + b\left(1+\frac{p}{100}\right)^{2} + b\left(1+\frac{p}{100}\right)^{3} + \ldots\ldots + b\left(1+\frac{p}{100}\right)^{n-1} + b\left(1+\frac{p}{100}\right)^{n};$$ subtracting the equation for A from the equation for $A\left(1+\frac{p}{100}\right)$ we obtain

$$A\left(1+\frac{p}{100}\right) - A = b\left(1+\frac{p}{100}\right)^{n} - b,$$ all the other terms cancel. This last equation we can write also as

$$A\left(1+\frac{p}{100}-1\right) = b\left\{\left(1+\frac{p}{100}\right)^{n}-1\right\};$$ as

$$A\left(1+\frac{p}{100}-1\right) = A\frac{p}{100},$$

we have

$$b = \frac{A\frac{p}{100}}{\left(1+\frac{p}{100}\right)^{n}-1} \text{ ..... (7)}$$

Should the plant after its useful life is terminated still represent a salvage value which should be taken into consideration, the annual depreciation charge b would become

$$b = \frac{A}{100} \times \frac{(100-S)\frac{p}{100}}{\left(1+\frac{p}{100}\right)^{n}-1} \text{ ..... (8),}$$

S represents the salvage value in per cent of first cost of plant or unit. The formulae (7) and (8) involve the use of logarithms to calculate the values of the depreciation charge b which may be

somewhat onorous to the average telephone man. Therefore we will make it easy for him by giving him tables to use. Before doing this, we will transform equation (8) by writing it $b = A \times \frac{(100-S)}{100} \times \frac{\frac{p}{100}}{\left(1+\frac{p}{100}\right)^n - 1}$ ...(9)

The term $A \times \frac{(100-S)}{100}$ is easily calculated; it is the term

$$\frac{\frac{p}{100}}{\left(1+\frac{p}{100}\right)^n - 1}$$

which involves the logarithms; therefore if we provide a table giving the values of this latter term for values of n up to 50 years and for various rates of interest p compounded annually, the reader can take the values of the second term from the table and multiply them by the first term to obtain the depreciation charge b. Of course, if there is no salvage, that is, if $S = 0$, we will have instead of equation (9) equation (7), which will make it still simpler.

Table of Values of $\frac{\frac{p}{100}}{\left(1+\frac{p}{100}\right)^n - 1}$ for p =

Years n.	3%	3.5%	4%	4.5%	5%	6%	7%
2.....	0.49261	0.49140	0.49020	0.48900	0.48780	0.48544	0.48309
3.....	0.32353	0.32193	0.32035	0.31877	0.31721	0.31411	0.31105
4.....	0.23903	0.23725	0.23549	0.23374	0.23201	0.22859	0.22523
5.....	0.18835	0.18648	0.18463	0.18279	0.18097	0.17740	0.17389
6.....	0.15460	0.15267	0.15076	0.14888	0.14702	0.14336	0.13980
7.....	0.13051	0.12854	0.12661	0.12470	0.12282	0.11914	0.11555
8.....	0.11246	0 11048	0.10853	0.10661	0.10472	0.10104	0.09747
9.....	0.09843	0.09645	0.09449	0.09257	0.09069	0.08702	0.08349
10.....	0.08723	0.08524	0.08524	0.08329	0.08138	0.07950	0.07238
11.....	0.07808	0.07609	0.07415	0.07225	0.07039	0.06679	0.06336
12.....	0.07046	0.06848	0.06655	0.06467	0 06283	0.05928	0.05590
13.....	0 06403	0.06206	0.06014	0.05828	0.05646	0.05296	0.04965
14.....	0.05853	0.05657	0.05467	0.05282	0 05102	0.04758	0.04434
15.....	0.05377	0 05183	0.04994	0.04811	0.04634	0.04296	0.03979
16.....	0.04961	0.04768	0.04582	0.04402	0.04227	0.03895	0.03586
17.....	0.04595	0.04404	0.04220	0.04042	0.03870	0.03544	0.03243
18.....	0.04271	0.04082	0.03899	0.03724	0.03555	0.03236	0.02941
19.....	0.03981	0.03794	0.03614	0.03441	0.03275	0.02962	0.02675
20.....	0.03722	0.03536	0.03358	0 03188	0.03024	0.02718	0.02439
25.....	0.02743	0.02567	0.02401	0.02244	0.02095	0.01823	0.01581
30.....	0.02102	0 01937	0.01783	0.01639	0.01505	0.01265	0.01059
40.....	0.01326	0.01183	0.01052	0.00934	0.00828	0.00646	0.00467
50.....	0.00887	0.00763	0.00655	0.00560	0.00478	0.00344	0.00238

Example: To find the depreciation charge b to be made annually on twenty private branch exchanges costing $500 each installed, assuming the useful life of private branch exchanges to be 15 years and the rate of compound interest to be six per cent. It is furthermore assumed that the salvage value of a private branch exchange amounts to five per cent of its first cost. With these figures formula (9) gives the value of b as

$$b = 20 \times 500 \times \frac{100-5}{100} \times \frac{\frac{6}{100}}{\left(1+\frac{6}{100}\right)^{15} - 1}.$$

It is $20 \times 500 \times \frac{100-5}{100} = 9500$. The value of $\frac{\frac{6}{100}}{\left(1+\frac{6}{100}\right)^{15} - 1}$ is determined from the preceding table as 0.04296, whence $b = 9500 \times 0.04296 = \$408.12$, which represent the annual charge for depreciation on the twenty P.B.X.'s.

To check the calculation, we will determine the value of b also by means of logarithms. The value of $20 \times 500 \times \frac{100-5}{100}$ is 9500 as before.

The value of $\frac{0.06}{1.06^{15}-1}$ is found as follows:

It is $\log 1.06 = 0.0253$ and $15 \times \log 1.06 = 0.3795$.

The number corresponding to 0.3795 is 2.3961, whence $1.06^{15} - 1 = 2.3961 - 1 = 1.3961$; thus $\frac{0.06}{1.06^{15}-1} = \frac{0.06}{1.3961} = 0.04296$, which is the same as found before.

69. Depreciation Tables

It will be understood that a separate value of b has to be determined for each unit of the telephone plant, because the useful life of the different units varies, and therefore the value of b varies. Each year when the depreciation is determined the depreciation charge calculated for the first cost at the beginning of operation of the plant must be increased according to the new construction added, and decreased by the amount corresponding to the cost of the unit replaced or discarded taking into account the salvage value.

It is difficult to say exactly what the useful life of each unit is, although enough time has elapsed since the introduction of the telephone to obtain a fairly accurate knowledge of the life of each unit; but conditions are not the same in every location nor in every exchange. The climate has a great deal to do with it, and also more or less the efficiency in handling the apparatus. However, below is given a list of values for "n," which may be considered as a fair average.

To this list is added the salvage value of each unit, which may be taken as the maximum to be allowed.

Then there is a column in the list headed "non-accumulative." Some telephone companies prefer to set aside each year the same amount for depreciation without regard to interest. These depreciation funds they invest either in the plant or hold in reserve. This is a simple way of writing off. The amount is easily determined by taking the original cost, subtracting the salvage value, if there is any, and dividing the remainder by the number of years of useful life "n" the plant or unit has to serve.

The other three columns give the annual depreciation charge as determined by equation or formula (9) for three different values of "p," the percentage of first cost of plant or unit in place, taking also into account the salvage values indicated in the second column of the table.

In the preceding table only bare depreciation, that is, the amount chargeable each year to create a fund sufficient to replace the plant at the end of its tenure of life, has been taken into account. For unforeseen reconstruction of portions of the plant, caused by changes in the physiognomy of the city or town, by floods, and by similar acts of nature and to cover such insurance, for which it is difficult to obtain reasonable rates from fire insurance companies, a reserve fund is desirable, which may be arranged on the basis given in the table of reserve fund below:

Units.	Per cent of first cost.
Pole lines	4½
Copper wire	3
Iron wire	3
Aerial cable	3
Aerial cable terminals.....	3
Messenger strand	3½
Drop wire, copper.....	4
Underground cable	2
Underground conduit, main.....	1½
Underground conduit, subsidiary.	2
Exchange equipment	2
Subscriber's station equipment...	2
Fireproof buildings	1

Attention is called to the difference between the first cost on which interest payments apply and the first cost on which depreciation and reserve fund applies. As a basis for the determination of the depreciation and reserve fund serves the actual construction and equipment expense, which should include:

1. Pole lines.
2. Wires (line and drop).
3. Messenger.
4. Cable terminals.
5. Cable (aerial and underground).
6. Conduit.
7. Exchange equipment and P. B. X.'s.
8. Subscriber's station equipment.
9. Buildings.
10. Furniture, tools, vehicles.
11. Supervision and engineering.

Interest, however, must be paid on all the above items plus: Moneys expended in securing franchise, right of way, etc.; cost of promotion, organization, brokerage; business, legal, accident and insurance cost during construction; printing, advertising, canvassing, etc., during development period; interest paid during construction; working capital required to start operation of plant.

Whether right of way is a depreciation or maintenance charge is a matter of opinion. As far as patent rights are concerned, it is a wise policy to charge patents off as soon as they are obtained.

The professors still disagree as to the best method of solving the problem of depreciation. In what we have said, we do not contend that we have brought the solution any nearer, but we believe that our contribution will assist the telephone man in working out his own salvation.

TABLE OF DEPRECIATION CHARGE FOR REPLACEMENT OF TELEPHONE PLANT UNITS

Units.	Life in years n.	Salvage, % of first cost in place S.	Non-accumulative.	Annual charge, % of first cost 3% Compound interest on first cost	4½% Compound interest on first cost.	6% Compound interest on first cost.
Pole line, exchange	10	0	10	8.72	8.14	7.58
Pole line, toll	16	0	6.33	4.96	4.40	3.90
Copper wire, exchange	15	40	4	3.24	2.93	2.58
Copper wire, toll	40	40	1.5	0.80	0.57	0.39
Iron wire, exchange	8	0	12.5	11.25	10.66	16.10
Iron wire, toll	15	0	6.66	5.38	4.81	4.30
Drop wire, copper	8	10	11.25	10.23	9.60	9.10
Aerial cable	12	30	5.83	5.00	4.52	4 18
Aerial cable terminals	12	0	8.33	7.05	6.46	6.00
Messenger strand	12	0	8.33	7.05	6.46	6.00
Underground cable, main	20	40	3	2.24	2.00	1.70
Underground cable, subsidiary	12	40	5	4.26	3.90	3.58
Underground conduit, clay, main	40	0	2.5	1.33	0.94	0.64
Underground conduit, clay, subsidiary	20	0	5	3.72	3.19	2.72
Underground conduit, fibre, main	20	0	5	3.72	3.19	2.72
Underground conduit, fibre, subsidiary	10	0	10	8.72	8.14	7.58
Exchange equipment	8½	15	10	9.10	8.61	7.94
Private branch exchanges	8½	15	10	9.10	8.61	7.94
Subscriber's station equipment	10	10	9	7.87	7.32	6.83
Loading coils	20	0	5	3.72	3.19	2.78
Fireproof buildings	30	25	2.5	1.58	1.24	0.95
Furniture, tools, vehicles, etc.	4	10	22.5	21.60	21.00	20.61

Knoxville Moves Conduit Without Service Stop

The wonderful growth of Knoxville in recent years has presented problems to the city authorities, one of the many being traffic congestion. The business houses and residences occupy the hills while the lower ground or valleys are taken up with railroad tracks and yards. Most of the hilltops are connected with each other by viaducts and to relieve the traffic congestion it was only a question of additional viaducts. The first of these was to be built on Broadway from Depot to Jackson street.

The general plan of the city was to raise the street above the railroad tracks and lower the grade over the top of the hill, making an improved thoroughfare with a six per cent grade. To hold this six per cent grade necessitated the rearrangement of any telephone plant along the streets to be improved and the lowering of the railroad tracks.

Along Broadway the telephone company had a conduit run consisting of twelve vitrified clay ducts laid on a four-inch base of concrete with a creosoted plank over the top. This conduit run would have lasted ages in its present location but was not designed or constructed to be moved.

One-fourth of the telephones in Knoxville, including those in the business center, were served through five large cables in this duct line. Thus the problem of the telephone company resolved itself into relocating its plant in such a way that it would not interfere with the building of the new viaduct or the grading of the street and at the same time give uninterrupted service.

How it was solved is told by W. F. Roberts in the Southern Telephone News.

Cable Duct Lowered

Passing over the different plans considered to meet the changed street conditions, it was finally decided to lower the duct and cables to conform to the new grade established by the city.

On Broadway from Depot to Jackson street, one line of the viaduct piers with their footings hit the conduit run in the center. To miss the line of piers supported by creosoted pilings, it was necessary to move the subway; and in order to hold the street level of the viaduct to the established six per cent grade necessitated the lowering of the railroad tracks which were over the duct line. So the combined structure of conduit and cables had to be moved four and one-half feet west and lowered four and one-half feet below its original grade.

The method of procedure followed in moving and lowering this duct may be interesting. The conduit was uncovered its entire length and planks placed on both sides with cleats filling the space between the outside of the planks and edge of the concrete. The cleats were provided to prevent the crumbling of the concrete when two strands of wire were placed around the entire structure every three feet.

Iron straps were placed under the conduit every six feet, through the ends of which threaded iron rods were inserted and extending through the timbers that spanned the entire ditch. The timbers supporting the conduit rested on a wooden track with posts to make it level with the center of the street.

Small iron rollers were placed under the timbers and the whole section pushed over by means of bars to its new location. A new and deeper trench had been dug, so the conduit was lowered by the use of wrenches turning the nuts on the threaded rods. The conduit was lowered to within an inch and a half of the bottom of the trench, which space was filled with fresh concrete.

An Interesting Problem

The moving and lowering of the conduit under the new viaduct presented its problems, but these were no greater than the handling of duct line on the top of the hill.

At the intersection of Vine and Broadway it was necessary to handle three sections of subway at the same time. The interesting part was that the conduit in its original location rested on rock that resembled marble.

Half of the new trench between Vine street and Western avenue was thirteen and one-half feet deep. This deep trench was necessary in order to lower the conduit from its original location to a point below the new street level.

It was necessary to build a wooden well from the top of lowered manholes to the old street level as the work was done in advance of the street grading work.

The whole job was handled so well that from a telephone service standpoint the people of Knoxville did not know that the conduit and cables were being lowered.

How to Read Telephone Circuit Diagrams

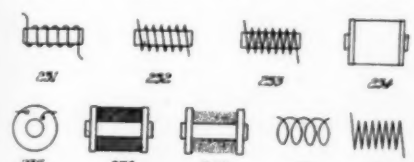
By DAVID S. HULFISH

CHAPTER V

(Copyright, 1927)

The electromagnet consists primarily of a coil of wire and a soft-iron core. See Figs. 231 and 232, which show the two elements properly related. Fig. 233 shows a simplification of the same symbol.

A single-wound straight-core electromagnet is shown in the symbols of Figs. 231 to 239, inclusive. Fig. 234 shows side view of a full spool of wire; Fig. 235



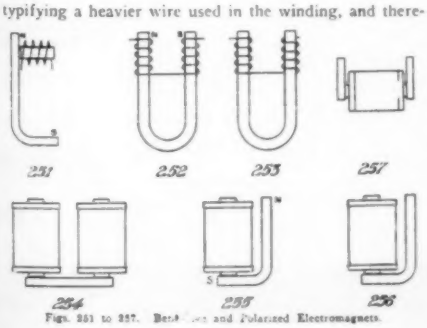
Figs. 231 to 239. Straight-Core Electromagnets.

shows end view of a spool, with terminal wires leaving it; Fig. 236 shows a sectional view through a full spool of wire; Fig. 237 shows a similar symbol; Figs. 238 and 239 show the coil of wire only, and properly are not symbols for an electromagnet.

Electromagnets having two windings are represented by the symbols of Figs. 240 to 250.

The symbol of Fig. 240 represents a double-wound electromagnet having two windings of equal turns; the symbol of Fig. 242 emphasizes the unequal resistance by showing one of the windings in heavy line value, typifying a heavier wire used in the winding, and therefore of lower resistance. Fig. 247 shows merely

typifying a heavier wire used in the winding, and there-



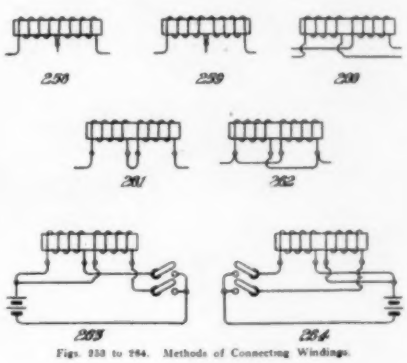
Figs. 251 to 257. Bent ... and Polarized Electromagnets.

a view of a spool, the partition in the middle of the spool indicating that there are two windings, one on each side of the partition.

Compare the symbols of Figs. 232 and 233. In Fig. 232 the direction of winding is shown, and the polarity of the core may be determined by the rule if the direction of current flow is known. In Fig. 233 this is not true. Compare Figs. 240 and 247 and the same is true.

In Figs. 248, 249 and 250 a peculiar form of double wound magnet is presented by the symbol. This is called the choked magnet, slow-release magnet or general magnet. In Fig. 247 a single turn of a conductor is shown about the core as one of the windings; in Fig. 249 this single turn is shown as a thick disk, or heavy ring. In construction, it usually is a heavy block of solid copper bored to fit the core and forced upon one end of the core. The symbol sometimes takes the form shown in Fig. 250.

Fig. 251 shows an electromagnet in the field of a permanent bar magnet. In



Figs. 258 to 264. Methods of Connecting Windings.

Fig. 252 the electromagnet is combined with the permanent magnet, the coils of the electromagnet being placed upon the poles of the permanent magnet.

There are two fundamental forms of electromagnet, the single pole and the double pole. The names are taken to designate the number of magnetic poles presented to the armature which the magnet is to move. The return-pole magnet is a specific type of double-pole magnet. Double pole magnets are shown in Figs. 252 to 257 inclusive. In Figs. 252 and 253 the horseshoe shape of core is shown, Fig. 252 being different from Fig. 253 principally in the showing of permanent magnetic polarization of its core by the letters N and S, meaning "north" and "south." Fig. 254 shows a U-shape magnet which is the most common of all forms of double-pole magnets. A heel piece of soft iron connects the rear ends of the two spools. Figs. 255 and 256 show return-pole-piece magnets.

Certain relations sometimes exist between the windings of multiple-wound magnets. The symbol of Fig. 258 shows a split-wound magnet; Fig. 259 a differentially wound magnet. In each of these symbols the windings are so connected in the symbols as to indicate that the device is wound to provide that special connection. Fig. 260 symbolizes a magnet with two independent windings which may be connected in any manner desired. The magnet of Fig. 258, when the helix is traced from extreme terminal to extreme terminal in either direction, at all times has its current effective to magnetize its core, yet either part of the core may be used independently. Fig. 259, when traced similarly from either extreme terminal to the other extreme terminal, in either direction, has its current ineffective or differential upon its core.

Fig. 261 shows series connection of the coils of a double-wound magnet and Fig. 262 shows multiple connection of a similar electromagnet.

With reference to current flow through a double-wound electromagnet, Figs. 263 and 264 show the two possible combinations. In Fig. 263 the coils are cumulatively connected. Fig. 264 on the other hand shows the coils differentially connected; when both of the coils are carrying current, the energy of one current is opposed to the energy of the other, and the core is magnetized by the difference only, or will not be magnetized at all.

The feature of utility in the electromagnet is found in its ability to draw a piece of soft iron toward its core when a current is passing through its winding, and to release the piece of soft iron when the current through its winding ceases. The piece of soft iron thus controlled is called the armature of the magnet. In a telephone receiver, the armature itself is the sound producing diaphragm of the receiver; in a ringer, with a tapper rod and a ball attached it acts to sound the signal bell. At times the armature may

Equip your subscribers' office with a P. B. X. switchboard that will operate well in conjunction with your main exchange.

Monarch

Telephone Equipment and Supplies

"For Greater Serv

American Ele

State an

Chic S.

Succ

Monarch Tele

Americ

New P. B. X. Switchboards

Meet All Classes of Common Battery Service

In these two new boards, the "Standard" P.B.X. and the "Feature" P. B. X., we have provided a standardized line of private branch exchange switchboards that will meet the requirements of the most exacting telephone company. They are complete in every detail and are standardized both as to local equipment and trunking features.

The "Feature" P. B. X. switchboard contains all of the features of the Standard board as well as many others that meet special operating and trunk requirements.

Both the "Standard" and "Feature" P.B.X. switchboards are built in two sizes, 30-line and 80-line. Each size will be carried in stock in three capacities, and can be operated with or without dial, according to the type of equipment in the city exchange.

Bulletin No. 80 outlines the features of these two P. B. X. switchboards. Write for your copy.

The COMO-FONE
The ideal telephone for P. B. X. Service

ater Serv hone Companies"

n Ele Company, Inc.

ate an Streets
Chic S. A.

Succ ss to
narch Tele ufacturing Co.

Americ Company

Burns
Radio Products
and
Office Specialties

for Assurance of Uninterrupted Service "COPPERWELD" Telephone Line Wire

The maintaining of normal service under abnormal conditions is the foremost requirement of a telephone system. Galvanized steel or iron wires soon rust and interfere with proper performance, often crippling an entire section.

The use of Copperweld, which cannot rust, insures absolute reliability of service and does away with regular maintenance and replacement costs.

"COPPERWELD"
Products Include:
Line Wire
Drop Wire
Ground Rods
Ground Wire
Clamps
Cable Rings
Staples, Nails

There never has been, nor is there now, any other "copper-covered steel" or "copper-clad steel" made like "COPPERWELD" —by the Molten Welding Process

"Engineering Data—Copperweld" a book of wire data for engineers and field men, sent on request. Write for your copy.

Copperweld wires "ride thru the storm." They stay up long after copper and (new) galvanized wires of equal and larger sizes are down. Size for size, Copperweld is 75% safer.

Copperweld wire ***cannot rust.*** The copper exterior is permanently and continuously molten welded to the steel core for all time. It can never crack, split or peel.

Copperweld wire costs less per mile than copper or galvanized wires of equal and less safety--based on ability to withstand sleet and wind loads--weighs less, and is easier to string.

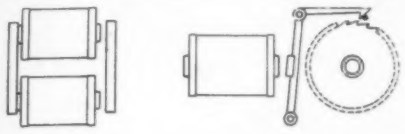
Take advantage of the saving Copperweld will effect on your lines.

Copperweld Steel Company
MAIN OFFICE & MILLS:-BRADDOCK P.O., RANKIN, PA.
30 CHURCH ST., NEW YORK 129 S. JEFFERSON ST., CHICAGO
403 RIALTO BLDG., SAN FRANCISCO

American Electric Company, Inc.
State and 64th Streets
Chicago, U. S. A.
Distributor to the Independent Telephone Trade

carry a pawl for driving a ratchet wheel, and at other times it may operate an electrical switch. Fig. 265 shows symbol for a double pole electromagnet with armature, and Fig. 266 shows symbolically an electromagnet with armature for driving a ratchet wheel.

A relay is an electromagnetically operated electric switch. Its function fundamentally considered is that of a connecting link associating two circuits in such relationship that the opening and closing of the second circuit may be controlled by opening and closing of the first circuit. For this purpose, the winding of a relay is included in the first circuit and the switch or contact points of the relay are included in the second circuit. This is illustrated in Fig. 267.



265 266

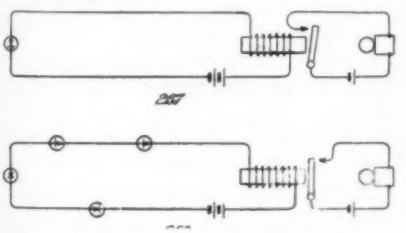
Figs. 265 and 266. Electromagnets with Armature and Pawl.

Fig. 268 is a diagram including a reverse-acting relay. This holds its local circuit open so long as its line circuit is closed, and vice versa. In this diagram, the opening of any of the four closed push button symbols would open the circuit; the armature is released, the local circuit is closed and the bell is rung.

These two relays show the simplest forms. For a few possible variations in types of relays and arrangements of their contacts, imagine the combination of any one of the electromagnets of Figs. 231 or 234 with any one of the switches of Figs. 197 to 229.

Any arrangement of contact springs desired may be combined with any arrangement of windings. A few typical illustrations will serve to give such an understanding of the principles of relay symbols as to make intelligible any of the innumerable variations which will be met in reading miscellaneous diagrams.

The simplest type of relay must necessarily be the simplest type of electrical switch operated by the simplest type of electromagnet.



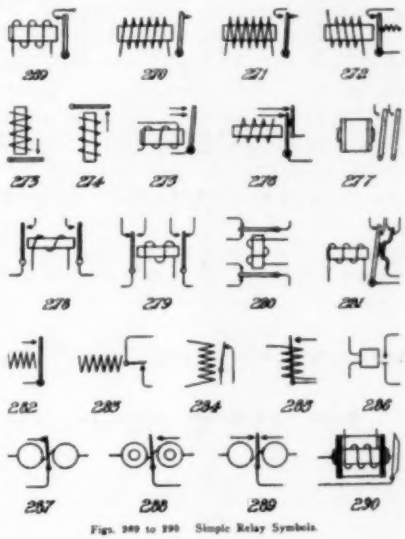
267

Figs. 267 and 268. Simple Circuit Combinations with Relays.

Fig. 269 gives a simple symbol. It is the magnet of Fig. 231 combined with the switch of Fig. 211. Fig. 270 symbolizes a reverse-acting relay of the simplest form. Fig. 271 shows a similar symbol for a make-and-break relay; it is the magnet of Fig. 233 combined with the switch of Fig. 224 or of Fig. 213.

Fig. 272 shows an elaboration of the symbol of Fig. 269, a tension spring being added.

The retractile spring usually is assumed in a relay symbol; it is shown but seldom. In Fig. 273 apparently gravity would restore the relay, but unfortunately that symbol is likely to be found as shown in Fig. 274.



269 270 271 272

273 274 275 276 277

278 279 280 281

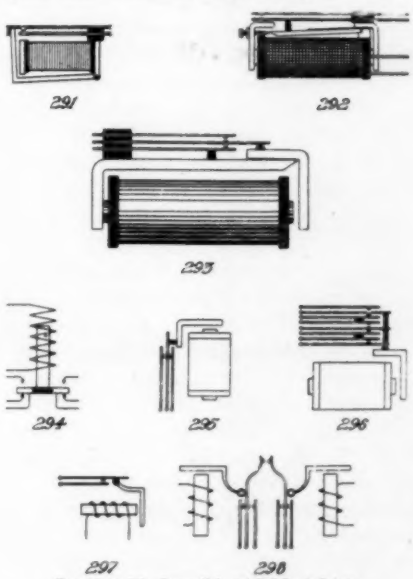
282 283 284 285 286

287 288 289 290

Figs. 269 to 290. Simple Relay Symbols.

Plural contacts are shown in the symbols of Figs. 275 to 281. The complex arrangements of plural contacts are simplified by showing two armatures in the symbols of Figs. 277 to 280. Figs. 279 and 280 show the switch of Fig. 198.

Figs. 282 to 285 show symbols in which the magnet symbol of Fig. 239 is used. The armature lever and contact point are combined with the helix in almost any manner. Fig. 286 presents a magnet in its side view without showing either the spool heads or the core ends, the relay contact being shown without detail of the armature. The symbols of Figs. 282 to 286 do not suggest to the reader the operation of the relay so well as do other symbols of the group; they are found in foreign diagrams more frequently than in America.



291 292

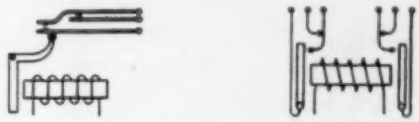
293

294 295 296

297 298

Figs. 291 to 298. Return-Pole and Bell-Crank Relays.

Figs. 287 to 289 show end view of the magnet of the relay, combined in each case with a symbol of armature and contact.

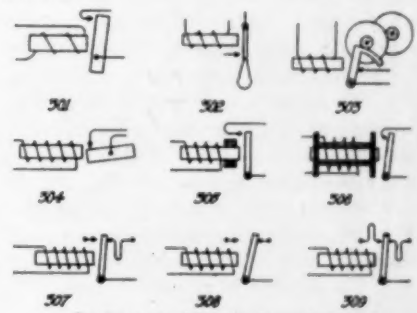


299 300

Figs. 299 and 300. Make-Before-Break Relays.

Fig. 291 is a symbol, but shows the type of mechanical construction of the relay. In Fig. 292 the magnet is of the style of Fig. 257, but the pole pieces are bent toward each other, the armature being hung between the pole pieces and the core. This arrangement shows the seeming anomaly of an armature moving away from its core. The tendency of armature movement is to close the air gap of the magnetic circuit, and this is done by an upward movement of Fig. 292, thus lifting the lower of the switch springs and closing the contacts. Fig. 293 shows the detail of a common type of return-pole-piece relay with bell-crank armature. Fig. 294 shows a relay without a core, since the armature occupies substantially the place of the core. When a current passes through the solenoid, the rod is drawn into the coil, and the switches attached to the end of the rod are operated.

Any of the symbols previously given may be used for any of the types of relays here shown with mechanical detail. In addition, the mechanical construction of the bell crank armature gives another set of symbols which also are used for symbols to represent any type of mechanical construction. Bell crank symbols are shown in Figs. 295 to 198 inclusive.



301 302 303

304 305 306

307 308 309

Figs. 301 to 309. Relays with Delayed Contacts.

Fig. 295 symbolizes the relay of Fig. 293. In Fig. 296, the magnet symbol of Fig. 234 is combined with the switch of Fig. 227. Fig. 297 shows another form of bell-crank armature symbol. Fig. 298 shows two such symbols so related that the energization of either relay alone will operate its own set of three springs, and the energization of both of the relays at the same time not only will operate the two sets of three springs each, but will cause the two long springs of the two

sets to be moved into contact with each other.

It is evident that the electromagnet of a relay may be wound in any way desired, and with as many windings as desired, and with any relation. The sub-

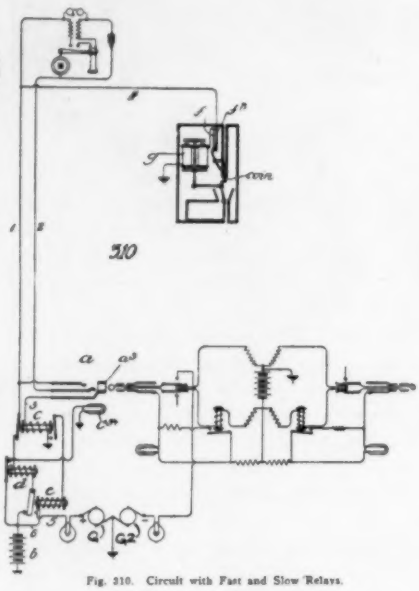


Fig. 310. Circuit with Fast and Slow Relays.

stitution of any magnet symbol, or any type of winding, from Fig. 231 to Fig. 264, inclusive, may be found in the symbol of any relay.

A make-before-break relay is symbolized in Fig. 299 and Fig. 300. This arrangement prevents the breaking of the controlled circuit even for a very small interval of time, and also they are used to give a short impulse only when the relay is opened or closed.

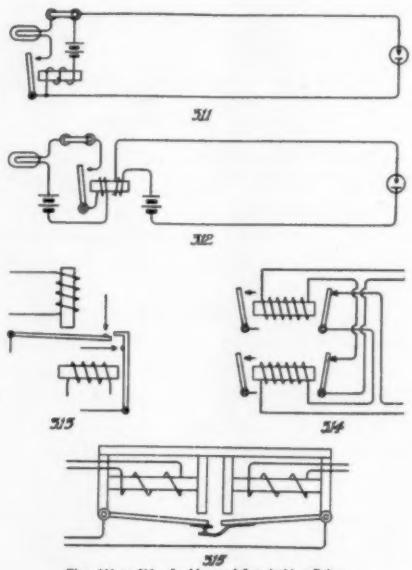
Relays with slowly acting armatures usually have their nature indicated. Fig. 301 gives a symbol indicating slowness by the size of its armature. Fig. 302 typifies a relay having an armature with an air vane. Fig. 303 shows a clock train as a delay element, a type of slow relay much used in automatic telegraphs. Fig. 304 shows a type used when a relay is required which is responsive to alternating current. Fig. 305 shows the sluggish-magnet symbol of Fig. 249 in combination with armature and contact. Fig. 306 shows the copper ring as a shell upon the core. A solenoid relay, such as Fig. 294, usually is a sluggish relay.

Still another symbol for a slow acting relay is shown in Fig. 307, in which it is indicated by the bent spring at the back contact that the contact point follows the armature during the early part of its movement, thus delaying the breaking of the armature circuit.

The back contact of the armature of Fig. 307 is called a "following contact" because the contact follows the armature for a portion of its movement.

Fig. 310 is presented as an illustration of the use of fast and slow relays in combination, as well as for an exercise in general skeleton-circuit reading.

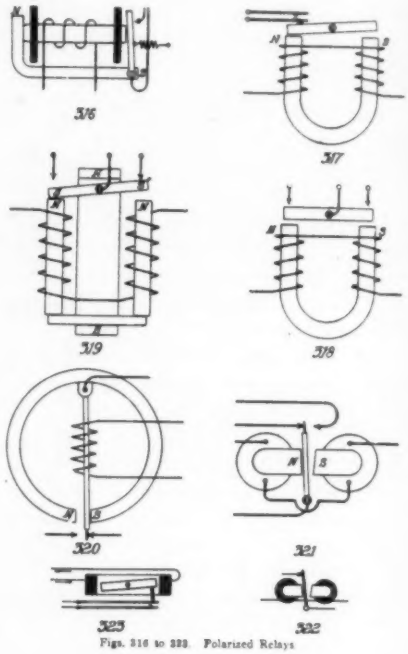
The only indication that the relay *e* is a sluggish relay is found in the size or thickness of its armature, as compared with the armatures of relays *d* and *c*. This diagram represents a cord pair at the central office, a line equipment with one line jack, a line, a substation equipment in the symbol of Fig. 146 with an optional change in the transmitter element of the symbol, and, finally, a coin-collecting device. This coin-collecting device is so constructed that a path from the line *l* to earth is formed when a coin is dropped into the slot of the device. A coin is in, as represented in the diagram, hence the path from *l* to earth is closed, and current is flowing from battery *b* at bottom of diagram through contact and armature of relay *e*, winding of relay *d*, contact and armature of relay *c*, wire 1, wire 4, coin-switch springs *f* and *f2*, and



Figs. 311 to 315. Locking and Interlocking Relays.

earth back to battery *b*. Relay *d* is energized and is shown properly in the diagram with its armature in its attracted position, and with its armature circuit closed. Upon the insertion of the plug *l* in the jack *a*, current will flow from battery *b* of the cord pair through wire 9 and its signal lamp, body of plug *l*, ring *a3* of jack, wire 3 and winding of relay *c* to earth, energizing relay *c*. This interrupts the circuit first described, because relay *c* attracts its left-hand armature. By the attraction of the right-hand armature of relay *c* path is closed for current through the lower battery *b* up through wire 6 and through the winding of relay *c* and thence through the contact to earth. This energizes relay *e*. Note that in the circuit traced through the coin device, the breaking of the circuit at the left-hand armature of relay *c* occurred before the movement of the armature of relay *e* was begun.

Upon the removal of the plug from the jack, relay *c* is de-energized because its energizing circuit is broken, by the de-energization of relay *c*, relay *e* also is de-energized because the release of the right-hand armature of relay *c* breaks the helix circuit of relay *e*. These two



Figs. 316 to 323. Polarized Relays.

relays are released practically at the same time, but the relative armature speeds are indicated by the size of the armatures, and the armatures of the relay *c* must be considered as acting before that of relay *e*. With *c* released and *e* still in its actuated position, circuit through the coin device is found not through battery *b*, but through generator *G*, through wire 5, through armature of *e*, through winding of *d*, through closed back contact of left-hand armature of *c*, through wire *l*, wire 4, switch *f2-f* and magnets *g* to earth. This condition lasts but a very short interval, because sluggish relay *e* immediately changes the circuit back that that circuit first traced in this study.

The conclusions to be reached after this study of Fig. 310 are that the magnets *g* are not responsive to the current through them caused by the battery *b*; otherwise there would have been no circuit for the generator *G* through the armature of relay *e*. Also, that the magnets *g* are responsive to current through them from the generator *G* and dispose of the deposited coin in response to that control, after which the switch *f2-f* is opened; otherwise, the relay *d* would remain permanently energized, and this would cause the lamp *c3* to burn permanently, since the relay *d* closes by its armature a path through battery *b*, lamp *c3* and earth. A further conclusion is that the electromotive force of the generator *G* is greater than that of the battery *b*.

AN ADVERTISEMENT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY

THERE are twenty-five Bell Companies, but there is but one Bell System—and but one Bell aim and ideal:

A telephone service for this nation so far as humanly possible free from imperfections, errors and delays, and enabling anyone anywhere at any time to pick up a telephone and talk to anyone else anywhere else in this country, clearly, quickly and at a reasonable cost.

WALTER S. GIFFORD,
President

A locking relay with its circuits simply arranged is shown in Fig. 311. By closing the push button at the extreme right of the diagram, current will energize the relay. Upon the closing of the contact, current will flow also through the battery, the two-point switch, the lamp, the relay contact and armature and the helix of the relay, thus giving a circuit for current even after the push button has been released. The lamp will burn and the relay remain energized by means of this locking circuit until the two-point switch between the battery and the lamp is opened. In Fig. 312 a similar arrangement is shown, but the relay has two windings.

A locking relay may be unlocked by another relay, as is seen, substituting the relay of Fig. 270 for the two-point switch in either Fig. 311 or Fig. 312. It sometimes may be unlocked also by shunting the locking coil.

Interlocking relays are shown in symbol in Figs. 313 and 314. In Fig. 313 the armatures are interlocking, and in Fig. 314 the circuits are arranged to the same end. In Fig. 313, when either armature is attracted, its free end interferes with the movement of the free end of the other armature, and the second armature therefore cannot be moved to close its contact. In Fig. 314, the helix circuit of each of the relays is taken through the normally closed armature contact of the other relay. When either relay attracts its armature, it opens the helix circuit of the remaining relay, making the operation of the second relay impossible.

Fig. 315 shows a compound relay, which in its nature is a pair of interlocking relays. When the right-hand armature is attracted the contact is closed, but when the left-hand armature is attracted the contact is broken. While the left-hand armature remains attracted the right-hand armature has no control over the armature circuit.

By providing for an initial magnetic polarization of a relay core, the relay may be made to discriminate between currents of different directions. The symbol of Fig. 316 discloses a polarized relay which holds its armature normally attracted. When the current is of proper strength and direction, the polarity of the core may be neutralized and the armature released, closing the armature contact. It is evident that the permanent magnet of such a relay may be replaced by a second winding.

In mechanical construction, types of polarized relays vary widely, and their symbols as adapted from the different mechanisms also vary widely. The symptom which may be taken to indicate a polarized relay is the occurrence near each other of a permanent magnet, a helix and a contact, with or without armature; or an armature between two poles or between two coils.

In Fig. 317, the armature is pivoted in the middle, with its contact-controlling end against the *N* pole of the permanently magnetized core. The helix is so wound in direction upon the two poles that when it is desired to operate the armature the *N* pole is weakened and the *S* pole is strengthened, thereby moving the armature.

Fig. 318 shows a symbol for a polarized relay having three positions for its armature. Retracting springs must be assumed by which the armature is returned always to its middle position, in which position it is shown in the symbol.

The polarized relay, as usually built, is in its nature a locking relay, and will operate to leave its armature in its last position unless retractile springs are provided. In the relay of the symbol of Fig. 319, the armature will remain in the position so long as no current flows through the helix, unless retractile springs exist, and they are not shown.

Figs. 316 to 323. Polarized Relays.

(To be continued.)

Completion of the Paris-Nancy-Strasbourg Cable

Paris, France—Completion of the Paris-Nancy-Strasbourg cable was one of the most outstanding accomplishments of the telephone and telegraph field in France during 1926. It was "cut in" officially October 1. This is the first long-distance, high-capacity cable yet constructed in France. The cable, which is armored, has a total length of 494 kilometers and its average depth underground is 60 centimeters. At approximately every 80 kilometers are located amplifying stations. The cable is made up of 284 wires of which 244 are used for telephonic communications and 40 for telegraph. This gives 122 telephone circuits, plus 61 phantom circuits, or a total of 183 telephone circuits working in the cable. Communication now can be made in fifteen minutes between Strasbourg and Paris, whereas before it took from three to five hours. The cable was constructed and installed by the Societe Lignes Telegraphiques et Telephoniques de Conflans-Ste. Honorine. The circuits of the cable and the amplifying stations were made by the Societe "Le Materiel Telephonique," Paris (Western Electric Co.).

Reparations Help Rebuilding of Belgium System

Antwerp, Belgium.—The Belgian telephone and telegraph reorganization plan has been completed in its main lines—will extend over several years. It is expected in the Belgian electrical industry that half of the orders for the supply of material will be placed with German firms on reparations account. Government circles have suggested to the Belgian electrical industry the conclusion of a working agreement with German, and eventually other foreign, electrical undertakings for the reorganization of the systems. The cost is estimated at 12,000,000 fr.

REMEMBER "WAY BACK WHEN?"

—*International Newsreel Photo.*

Neufchateau, France.—Photo shows French workmen as they took down the wires, insulators, and later the Poles of the telephone lines between Neufchateau and Colomeyles-Belles, a distance of ten miles. This is one of the last remaining evidences of the presence of the Americans in France during the World War

Studying the Details of Telephone Work

CHAPTER V

By E. R. COLLINS

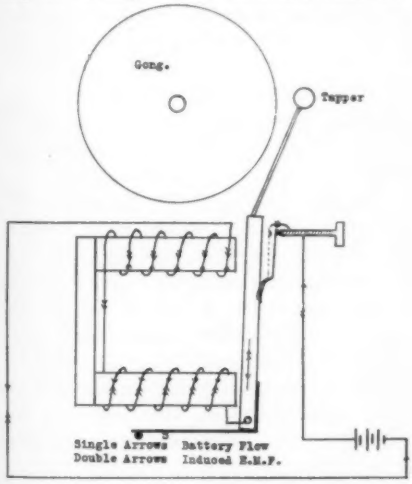
Wire Chief, Manitoba Telephone System

A telephone line is of little use without a signal of some sort to call the desired parties to the telephone. To send a tone that would operate the receiver diaphragm is of little use on account of the short distance this can be heard. A receiver with a tin horn attached is sometimes used for railroad telephones, where the operator is not far from the instrument. Aside from that use it is only of passing interest.

There are two types of electric bells which can be heard for considerable distances; they are the vibrating bell, such as you use on your front door, and the polarized bell, which is used on our telephones.

The Vibrating Bell

The vibrating bell is such a common piece of apparatus that it would seem unnecessary to spend any time considering its construction. There are two great objections to using this type of bell for telephone work. The first is the sparking or arcing at the contacts, and the other is the large amount of energy required to operate it satisfactorily.



(*Fig. 33*)

In Fig. 33 is shown a skeleton of an ordinary vibrating bell. There is an electro magnet of the horseshoe type, an armature to which is attached a contact spring, and a back tension spring, "S." The contact spring normally rests against a stationary contact screw. These contacts are made of platinum, German silver or some other alloy having the power to resist the burning effect of the electric spark.

The two coils are so connected that one pole will be a north pole and the other a south pole. The tension spring, "S," holds the armature back so that the contacts make with good pressure.

When battery current is allowed to flow through the coils, the armature and contacts, the magnet is energized. A strong magnetic field attracts the armature. The contact spring on the armature is adjusted so that it bends back against the contact screw and does not pull away until the armature has made part of its stroke.

As soon as the contact is broken the battery stops flowing and the magnetic field commences to collapse. When this is taking place an induced current is set up in the coils in the opposite direction to the battery current. The induced current is shown by the double arrows. Until this magnetic field has weakened, the magnet will hold the armature. The armature therefore stays pulled up until after the induced current is set up. This attempts to flow back through the battery circuit, but the contacts are open. So this ambitious induced current simply jumps the gap at the contacts, thus causing a spark. This spark in time will blister and even weld the contacts so that the bell cannot ring. As the armature repeats this operation, ringing the bell, the series of sparks appear as a steady flame. There are different methods of overcoming this sparking which we will consider as we come to them.

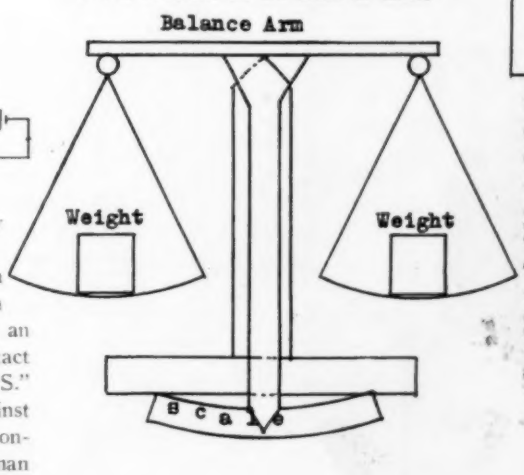
The spring, "S," is quite still, so that the armature is forced back as soon as the magnetic pull has become weak enough. The battery current then has to overcome the pull of this spring each stroke of the bell. This uses considerable electrical energy, which in a large telephone system would be quite costly. So on account of these two objections we will count the vibrating bell out for our purposes.

The Polarized Bell

In Fig. 7 (March issue) was shown an assembly of a permanent magnet with a yoke and two pole pieces. The picture of the magnetic field showed that it was divided, and that when the upper end of the permanent magnet was *north* the two pole pieces would each be *south*.

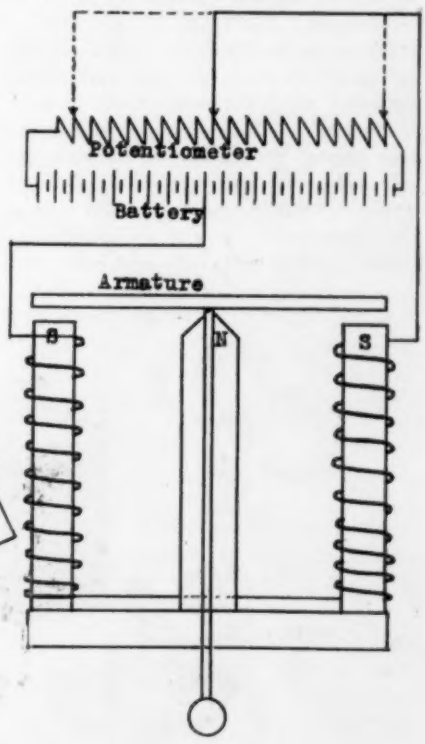
In Fig. 21 of the April issue was shown a pair of electro magnets with a yoke and armature, and the coils were so connected that one pole was north and the other south. We also observed that when the battery flow through these coils was reversed, the poles were reversed.

In Fig. 34 the right hand figure shows



Weight Balance

Fig. 34



Magnetic Balance

Fig 34-A

a combination of Fig. 7 and Fig. 21. The armature in this case, however, is balanced in the center on the upper end of the permanent magnet, which we have shown tapered to a knife edge.

In the left hand figure we have drawn a scale or a balance. There is an arm balanced on a knife edge support, and from the two ends of this arm are suspended two plates, each with a weight. If these weights are equal and the arm equally centered the arm should be horizontal or be balanced. Now, when the arm is balanced, a few grains of sand will upset the balance and cause one end of the arm to go down and the other come up and the indicating arrow to move across the scale.

Experiment 25

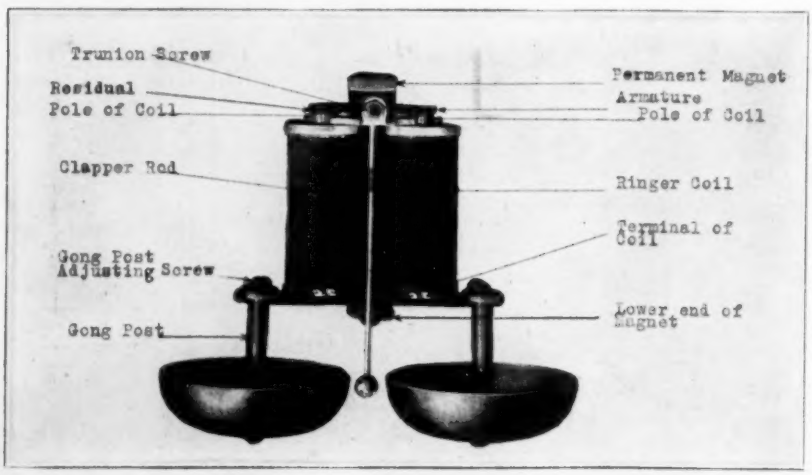
Now, referring again to the right hand figure. Here we have the two coils connected, one to the center of a 6-volt battery and the other to the center arm of a potentionometer of, say, 400 ohms. (A potentionometer such as is used in a radio set will be quite suitable for the experiment.) With the arm in the center of the resistance, or near there, a point can be found where the pull on the armature will be so evenly divided that the clapper weight will be free to move either way. Now move the potentionometer slightly to one side and note that the balance of the arm is upset. Moving the potentionometer arm from side to side will cause the armature of the polarized balance to move to first one pole and then the other. The point I want you to get is that very little change in battery current is required to upset the balance.

When we had an even pull from the two south poles on the two ends of the armature, the force being evenly divided, the armature did not move. When we pass current through so as to make the left coil *north* and the right coil *south* we have added to the *south* polar pull of the right coil (due to the permanent magnet) the amount of *south* polar pull set up by the current flowing in the magnet, and we have taken away from the *south* polar pull of the left magnet (due to the permanent magnet) the amount of the north polar pull in the left coil due to the battery flow. Since we strengthen the pull on the one end of the armature, and weaken the pull on the other end, the armature is bound to move. By reversing the direction of the battery current through the coils we can cause the armature to change its position in step with the period of battery reversal.

In Fig. 35 is shown a cut of a typical polarized bell. There are many types of polarized bells in use, but all act on the same principle. The armature is pivoted at the center, and the pivot screws are called *trunnion screws* and the nut on the screw a lock nut. A thin piece of grass is fastened to the inner side of the armature to prevent the iron armature, which is magnetic, from touching the cores, which are magnetized. A thin layer of non-magnetic material between the pole of the ringer coil and the armature will prevent sticking.

The gongs are adjustable and should be so adjusted that there will be a separation of about one-sixteenth of an inch between the clapper and the nearest gong. If the clapper is allowed to rest against either gong the vibration of the gong will be dampened and the bell will ring poorly.

The permanent magnet of a polarized bell must be able to set up a strong field, else the bell will ring weakly. A new magnet is the only remedy where the magnet has lost its strength. But unless you are careful your spare magnet may be worse than the one you are taking out. If a permanent magnet is allowed to be knocked around in a tool bag with a lot of tools the magnet will quickly lose its strength. Provide a piece of soft iron to put over the poles of the spare magnet to act as a keeper. This keeps the magnetic field closed and the magnetic flow will be in one continuous direction, which will help it to retain its strength. Striking a magnet with a hammer or other jars or blows will shift the magnetic field, so that the magnet should be protected from jars by keeping it wrapped in a piece of cloth in a small cardboard or wood box. This may seem like a waste of time but it may save you a lot of time when you need a new one.



(*Fig.* 35)

Ringing Current Supply

In telephone work there are three different kinds of electrical energy made common use of: Battery or transmitter current. This is direct current. Direct current is also used to operate relays, lamps and switches.

Talking current is spoken of when we refer to the voice currents which are sent over the line when speaking.

Ringing current is used to ring bells and other signals. The usual ringing current has a frequency of about 16 cycles. This is abbreviated and written 16~ where the sign is a miniature of the curve shown in Fig. 26.

There are several other types of alternating current used, such as busy tones, busy back tones, trunk or dialling tones, howler tones—and these are nothing more than alternating currents at different frequencies.

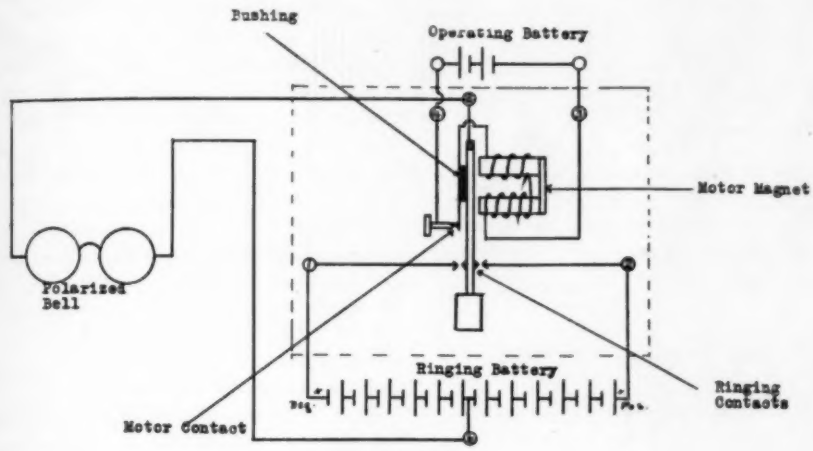
The two general sources of ringing current are the magneto generator and the pole changer or battery interrupter.

The Ringing Interrupter

In Fig. 36 is shown the simplest type of battery interrupter or battery reverser, or pole changer. All names refer to the same thing. This consists of a vibrating unit similar to the mechanism of the vibrating bell. Instead of the armature moving a weight to strike a gong, the weight is made large and heavy, and is to control the speed of frequency of vibration. Raising the weight will make the armature vibrate faster, and lowering it will make it run slower. The magnet in this apparatus is called the *motor magnet*, and the vibrating contacts connected to the magnet the *motor contacts*. In Fig. 36 we have shown the motor contacts insulated from the armature by bushings. These are indicated by the heavy black line between the armature and the springs. *Where this is shown in blue prints it indicates that the two pieces separated by the heavy marking are fastened together mechanically, but separated electrically.* The battery which operates the motor magnet is called the *operating battery*, and the other battery shown is called the *ringing battery*. The operating battery is usually from 2 to 6 volts, and the ringing battery will be about 200 volts.

At the center point of the ringing battery a tap or connection is taken off. This is usually connected to ground, and a ground connection is shown at No. 6

on Fig. 36. The left end of the ringing battery is negative and the right end positive. Since the whole battery is 200 volts, one half of it will be 100 volts. So if the contact of the armature is at the left, it closes the circuit of the negative



(*Fig.* 36)

battery of 100 volts, which flows out at No. 5 through the bell and back to No. 6. This will cause the bell to strike the gong. Then the armature of the pole changer, swings back to the right and makes contact with the positive battery of 100 volts; current flows out through 6 and through the ringer and back at 5. This reversal of current will cause the bell clapper to strike the other gong. When the armature has closed the right contact it has completed its cycle and produced an alternating current of one complete cycle. The weight of the armature when adjusted to swing from center to left, back to right, and back to center, 16 times each second, will produce a ringing current of 16-cycle frequency. In Fig. 36 the bell is shown by the drawing which looks like a pair of horn-rimmed glasses. This is the conventional marking for a polarized bell, or polarized ringer.

Magneto Generator

Another type of alternating current supply is the *magneto generator,* or *ringing machine* as it is called. It is often referred to as simply *magneto.*

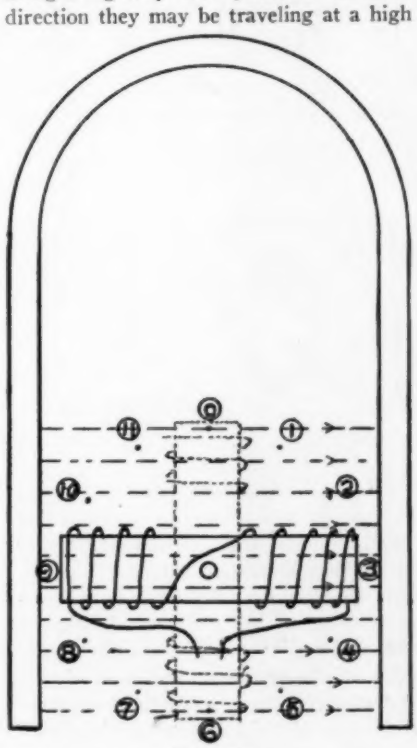
While the construction of such a machine is well known, there are a few points about its operation that we will do well to study. In the April issue, in Figs. 19, 20 and 21, we found by experiment that when battery current was passed through an electro magnet a magnetic field was set up. There is a very small period of time that it takes the magnetic lines to arrange themselves. This is the period of magnetic disturbance. After the disturbance is over the current continues to flow and holds the magnetic field extended. As soon as the current supply is cut off the lines collapse or recede, and during this disturbance of collapse they cause a current to be induced in the coil.

In Figs. 22 and 24 we found by experiment that when a permanent magnet caused a magnetic disturbance in the core of the electro magnet, induced currents were set up. An induced current occurs when the magnet is approaching the core; no induced current flows while the magnet remains in contact with the core, and a reverse current is set up when the magnet is moving away from the core. So it is only while the permanent magnet is in motion that any current is induced.

Now it makes no difference whether it is the permanent magnet that is moving or the electro magnet. The results are the same.

Forces at Right Angles

When two automobiles are being driven along a highway side by side in the same direction they may be traveling at a high speed and yet one has no effect on the the other. But as soon as one auto changes its angle of motion so that it tends to cross the path of the other, then something happens. And if the two cars are traveling at right angles to each other at high speed, when they come together the results will be worse than they would be with only a sideswipe.



(*Fig.* 37)

From this we can deduce the law that when two forces are crossing each other at right angles the stronger force will induce a change in the condition of the other. This works out electrically in regard to magnetism and electric flow. They always act with greatest intensity when working at right angles.

Experiment 26

An experiment to prove this: On a piece of board draw a circle as shown in Fig. 37. Now a circle has 360 imaginary divisions called degrees. We have marked the circle in divisions of 30 degrees each. Drill small holes at the points marked 1 to 11 (holes just large enough for a finishing nail). At the center of the circle mount a piece of soft iron about one-halt inch square with a hole drilled through the center. The iron used in Fig. 9 can be used for this. Around the iron wind a layer of paper and then about 200 turns of No. 30 magnet wire (smaller will do). Leave space at the center for the mounting nail. Now fasten a horseshoe magnet (the one used in Fig. 9 will do) on the board so that the iron armature will turn without touching the pole of the magnet. Connect the ends of the coil with some flexible cordage to the coil No. 2 such as used in Fig. 22 and 24. Place the compass over the coil, so that the compass needle is at right angles to the coil. Lay a weight over the cord so that the coil and compass will not be moved.

Set nails in holes 11 and 1 with the armature at position 0 and 6. Now move the armature between points 11 and 1 and observe the action of the compass.

Now change the nails and move the armature between points 0 and 2 and observe the movement of the compass. Then proceed to positions 2 and 4 and observe the deflection. Proceed around the circle in this manner. The greatest deflection is observed when the armature is moving between points 2 and 4, and weakest between 11 and 1 and also, of course, between 7 and 5. Note carefully that when the end which was originally at 0 starts to move from 6 to 7, the direction of the compass needle is reversed.

When the armature is at the position as shown by the dotted lines the turns of wire were parallel to the magnetic lines of the permanent magnet. This can be verified by referring to the magnetic picture in Fig. 9, position No. 3. When the armature is moving between 2 and 4

the turns of wire are at right angles to the magnetic lines. This bears out the statement that the greatest effect is had when two forces are working at right angles.

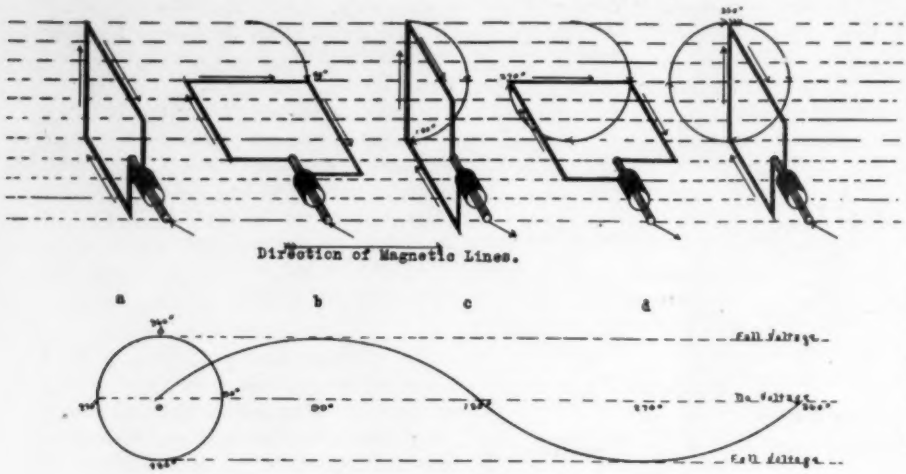


Fig. 38

Wave Formation

In the previous experiments we proved that there were currents induced in the armature winding when it was moved in the magnetic field in a rotary motion. In Fig. 38 is shown by the broken lines at the top of the drawing the magnetic flow between the pole of a permanent magnet. The magnet is omitted for simplicity. At positions a, b, c, d, e is shown a loop of wire connected at one end to a ring and the other end to the shaft that supports the loop. At (a) the long wire is shown at the top of the loop. At the lower part of the drawing is shown a figure. The circle represents the motion of the loop. The no voltage line shown is crossed by the curved line directly beneath (a). This indicates the amount of current flowing in the loop at this position. At position (b) the loop has turned 90 degrees or one-fourth of the circle. The loop has moved from being parallel in motion to the magnetic flow, till it is moving at right angles at (b). Directly below (b) the current flowing in the loop is shown by the curved line which touched the full voltage line when the loop has turned 90 degrees.

At (c) the ring wire (the end connected to the ring) has come to the bottom and is moving parallel with the magnetic lines again. The voltage here is shown at no voltage again when the loop has turned 180 degrees, or one-half of the circle.

The ring wire has been moving downward through the magnetic field for the first 180 degrees, and the other side of the loop has been working up. Since these two wires are moving in opposite directions in a magnetic field, the induced currents will be in opposite directions to and from the front of the loop.

During the first half revolution the current was toward the ring, but during the last half it will be toward the other end as this is now coming down through the magnetic field.

From 180 degrees to 270 degrees the voltage will rise in the opposite direction to the first half revolution, and will die out again to no voltage when 360 degrees is reached.

The curved line in the lower part of the drawing is called the *sine wave*. This shows the approximate voltage flowing in the coil for different angles of rotation.

Character of Wave

We have all noticed the sound of ringing current in a telephone receiver. The sound produced by some machines is very unpleasant while others have a smoother effect. This is due to the character of the alternating current set up.

In the upper drawing, Fig. 39, is shown the magnet and armature used in Fig. 37. The circle represents the complete revolution of the armature, and is divided in 30 degree section. At the right is shown as cross section formation which we call a graph. The vertical lines indicate the voltage in the armature, and the horizontal lines the degree of rotation. In Fig. 37 we noticed that there was very little current induced between points 11 and 1 or between 330 degrees and 30 degrees. So in the graph we show very little rise in voltage for the first 30 degrees. At 30 degrees the voltage is shown to be 10. From 30 to 60 the iron core of the armature is coming into the field, and more magnetic lines flow through the core, and this being at right angles to the winding, will induce a higher voltage. At 60 degrees we have indicated the voltage to be 20.

From 60 to 90 the magnetic flow is heavy through the core or armature, and we show an abrupt rise in voltage up to 50 volts. There was a rise of 30 volts for the last 30 degrees of rotation, while there was only a rise of 20 volts for the first 60 degrees of rotation.

There are then 60 degrees of high voltage and 120 degrees of low voltage for each alternation. This abrupt rise of voltage is caused by the shape of the armature and the magnet.

In the lower section of Fig. 39 is shown a permanent magnet with curved pole pieces, and an armature with curved ends. You will note that the magnetic field at no time is opened as much as in the upper figure. As soon as the armature starts to move, the magnetic flow commences to pass down through the armature as shown by the dotted line, and in passing through the core is cutting the winding of the armature at right angles. With this shape of armature and pole pieces for the magnet, the rise of voltage is more gradual as shown by referring to the graph in the lower part of Fig. 39. The curved line in the second graph shows the formation of a sine wave.

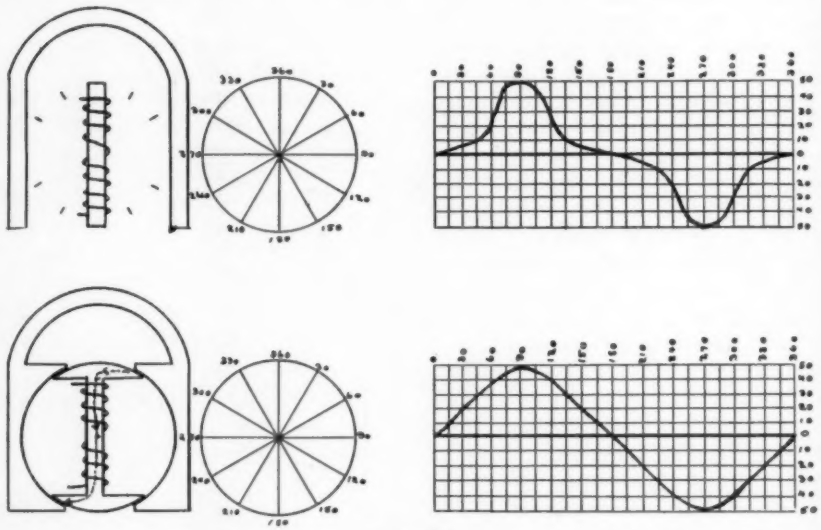


Fig. 39

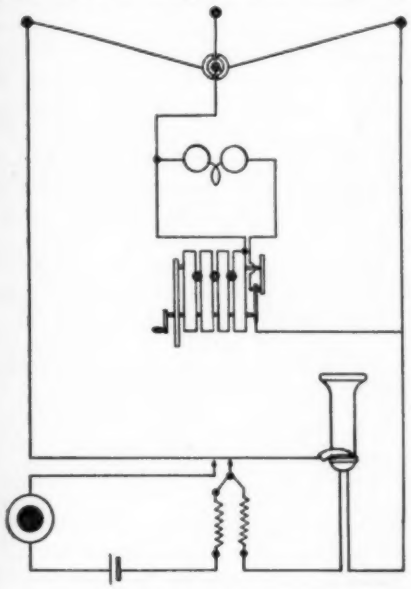
An article on Inductance will appear in the July issue.

LINE AND DESK

SELECTIVE RINGING QUERY ANSWERED

Ray Blain, a frequent contributor to this department, has the following suggestions for two-party selective service in local battery exchanges:

"Regarding the query in May, 1927, TELEPHONE ENGINEER regarding the two-party selective ringing for magneto exchanges, I believe that the best arrangement, if jack per station can be used, was outlined by me under 'Line and Desk' in the issue of December, 1925. If two-party jack per station service cannot be used then a drop with a center tap

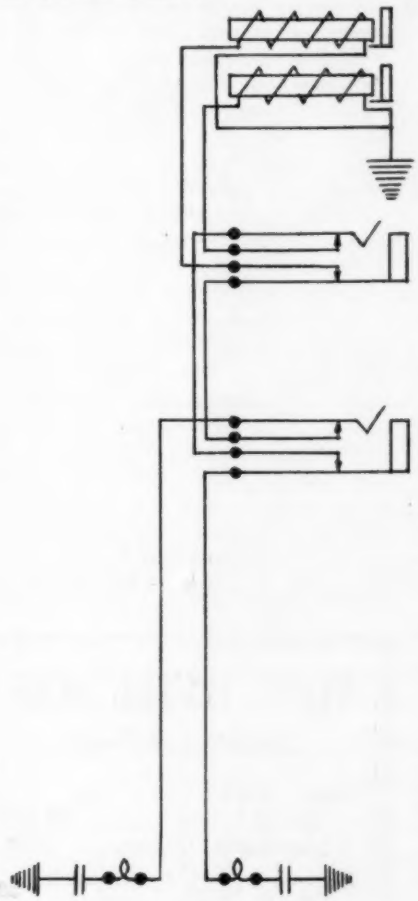


L. B. Set Modified for 2-Party Selective Service.

grounded must be provided. If the drop is hooked up straight across the tip and ring of the line, when station No. 1 rings from ground to the tip side of the line, the generator current will pass over the tip side of the line through the drop, ring side of the line, through the bell of station No. 2 to ground and ring both bells. This would happen regardless of the size of the generators or the resistance of the bells or drop.

"The jack per station is usually desirable for a magneto exchange as the cord circuits are seldom equipped to ring on the tip and ring side of the line to ground. This can be taken care of on jack per station by reversing the connections between jacks.

"The system as described in the December, 1925, issue was adopted after several schemes were tried out without success. This system worked just as successful as any selective ringing system on common battery."



L. B. Line Current Arrangement for 2-Party Selective Service.

Begging Mr. Blain's pardon for overlooking his previous contribution, we hasten to reproduce the sketches submitted with his December, 1925, article.

CO-OPERATE TO STOP LOSS FROM GRASS FIRES

It is a common practice of the farmer to burn the dead grass and weeds along the fence lines on the public highway. These fires destroy many telephone poles and guy stubs, and sometimes bring down the wires over the roadways where they endanger the safety of the traveling public. In dry, hot weather telephone poles are often entirely consumed by fire started in this way.

The landowner's fence usually suffers, especially if it has been constructed with wooden posts. If, however, the fence has been constructed of steel posts, the farmer may believe that the fire has caused him no loss. He will probably overlook the fact that the fire has destroyed the galvanizing on his wire and left it in a condition to rust rapidly. We have known cases where the burning of grass and weeds along the fence line has removed practically all the zinc protection from new woven wire fencing. The same thing happens to new barber wire. Rust immediately begins its attack and in a few years the fencing and wire will become worthless.

Farmers are often encouraged by highway officials to burn off the roadside. Articles are published in local newspapers and in farm journals pointing out the advantages of burning the trash along the highway. Attention is called to the fact that the roadside is often a breeding place for foul weeds which will spread onto the adjoining lands. These weeds are difficult and often impossible to reach with the mowing machine, especially where the telephone poles have been set at some distance from the fence line.

Wherever practicable it might be well for the telephone company and the landowner to arrange for the location of the telephone poles in or close to the fence, the farmer consenting to the necessary extra trimming of trees and to the overhanging of cross arms on his premises. This arrangement will allow the mowing machine to cut close to the fence and keep the roadside in such condition that there will be no occasion for the use of fire to clean it.

Telephone men are well aware of the effect of fire and smoke on galvanizing. They know what happens to the wires at railway crossings, but the farmer may not be aware of the damage his fire has done to his fencing. Our suggestion is that the telephone company get this information over to the landowner. If he knows that a roadside fire will damage his property he will be cautious and will be more ready to cooperate with the telephone company in an effort to avoid mutual losses.

Contributed by R. L. Parker.

PREVENTIVE MAINTENANCE IN THE CABLE PLANT

Methods employed in combating cable trouble have changed considerably in the last few years. At one time we waited for trouble to assert itself before men were sent out to locate and clear the defective spot, which meant an interruption of service to the subscriber in nearly every instance. As our outside plant continued to grow our ideas changed and we saw where money could be saved, also the inconvenience to the subscriber could be greatly reduced if a portion of this trouble was located and corrected before there was any actual interruption to the service.

At the present time we have Preventive Maintenance, as well as Routine Maintenance which covers the defects which are not found on inspection, together with causes beyond our control such as storms, fires, bullet holes, high tension burns, etc.

A routine inspection of the cable plant was found to be the best solution to locate defects. We must emphasize that the success of this method is largely due to the thoroughness of the inspector. This man with a helper is equipped with a Ford car which makes it possible to carry sufficient tools and material to repair all trouble found, with the exception of broken cable armour, which he tapes thoroughly to prevent moisture entering the cable and interrupting service. He then reports the location of the break, together with the size of sleeving required, and the first time a splicer is in this locality the sleeve is wiped on the cable. This type of defect is by far the most serious problem, inasmuch as about one-third of our entire trouble is caused primarily by broken armour. The reason for its breakage can be traced to any number of reasons. Weak points are always present after a cable has been in plant any length of time, and the continued contraction and expansion of the armour due to temperature changes will break the lead at any weak point. It is then only a matter of time before sufficient moisture enters the cable to effect the working lines. The number of lines depends, of course, upon the size of the cable involved. Our efforts of preventing trouble are directed toward locating breaks in the armour and correcting weak points which would eventually break. Other factors are not overlooked, such as electric light wire clearance, boxes and terminals inspected and repaired, cable rings placed and the general physical condition of the cable brought back as near as possible to its original form.

The actual amount of money saved by this rejuvenation is hard to compute. However, a few figures might be of interest. The average cost to locate and restore service on a routine case of cable trouble is approximately $14.00. In the past year we inspected 964,968 feet of aerial and block cable and discovered and repaired 2,576 places which would have eventually developed into a routine case of trouble, at a cost of $14.00 per case. This would have meant the expenditure of $36,064, whereas the cost of the prevention work was less than $4,000, in labor and transportation.

The value of preventive maintenance is obvious. To the telephone company it means dollars and cents, and to the subscriber uninterrupted service.—A. S. Meade in The Rochester Telephone Bulletin.

WET LADLE IN HOT LEAD IS DANGEROUS

"If I had read just one paragraph years ago which is now in our safety code book it would have saved me from a painful experience," said one veteran in our company. "But no one had told me about it and there was no safety code to warn me so I had a close call.

"It happened some years back before I was employed by the Northwestern Bell company. I started the fire in a furnace to heat some lead, and while the metal was getting hot I placed the ladle on the grass. It was early in the morning and the dew was still on the grass.

"When the metal was hot I picked up the ladle and stuck it into the pot of molten lead. There was an explosion. I was pelted from head to foot with hot lead. Fortunately it missed my eyes, but it burned through my clothing and I was a mass of blisters. The dampness on the ladle had caused the hot lead to explode.

"On page 62 of the code book there is a paragraph which reads, 'Dampness in hot material will cause an explosion—always see that ladle or additional solder is perfectly dry before placing in pot.'

"As I said before, if I had only had the opportunity to read those lines, or if someone had just taken the time to tell me that, it would have prevented that accident which might have resulted seriously if the hot metal had not missed my eyes," concluded the telephone man.—Northwestern Bell.

New Hotel Eitel
Chicago
The Next Time You Come
to Chicago make your visit a splendid success by stopping at this beautiful new hostelry.
Room and Bath, 1 person —$3.50, $4, $4.50, $5
Each additional person, only $1
Room and Bath, twin beds—$6, $7, $8
Under the personal supervision of ROBERT J. EITEL and MAX EITEL
Delaware Place at Rush St.
Just a few blocks from the Loop

STEEL HOTEL SETS

Complete and Tested

Dean Electric Co.
straight line $2.50
Harmonic ringers ... 3.00

Stromberg - Carlson
(flush transmitter)
straight line 2.50
Harmonic ringers ... 3.00

Stromberg-Carlson (adjustable transmitter),
straight line 2.50
Harmonic ringers ... 3.00

Western Elec. Co., 1000, 1600 or 2500 ohm.....6.00

Above telephones completely refinished — $1.50 extra.

Buckeye Telephone & Supply Company

Columbus, - - Ohio

Unassembled Connector

BRIDGING twisted pair to twisted pair, a practical application of the Kearney Solderless Service Connector.

FOR Telephone Lines in making party line taps, order Catalog No. 86. The tap can't slacken off. This connector is for No. 12 wire or smaller.

ASK ABOUT KEARNEY CERTIFIED MALLEABLE SCREW TYPE ANCHORS

Kearney Guy Wire Serving Clips. Eliminate Serving End of Strand. Made of Aluminum, Copper, and Galvanized Iron.

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

4226M Clayton Ave.

FOREMAN IS KEY MAN IN ACCIDENT PREVENTION

In the following excerpt from an address by General Plant Manager L. N. Stock of the Long Lines Division of the American Telo & Tel. Co., published through the courtesy of Long Lines, the importance of the foreman in accident prevention work is very forcibly set forth:

"I can think of no closer mutual interest between the management and the field forces than this question of safety. The real solution of our accident problem depends largely upon whether the management and men think together. They must be in absolute agreement on all phases of the accident prevention work before real results will be accomplished.

"Our safety policies, therefore, must start at the very top of the company and extend through the line of organization to the last employee. Safety must be the first consideration in starting any work. It must be kept constantly in mind from the time the work is laid out until its final completion.

"The keystone of our entire set-up for carrying out accident prevention work is the foreman. He can do more than any official or safety committee, but he must do it by leadership and co-operation with the workers. If he is interested in properly discharging his responsibilities he must be interested in the subject of safety.

"The use of safety appliances as well as improvised safety measures and precautions and warnings are a part of his duties. Every dangerous place or practice on the job he has laid out should be clear in his mind. Not only must he point out to all new employees any hazardous or dangerous practices before they are permitted to go on the job, but he must start these men in the right direction by showing them that every one in the gang is pulling together for safety. He should also insist on the care of slight injuries.

"If a foreman is in dead earnest about the safety of his workmen and is doing everything in his power day by day to protect them, he will get his men with him and lead them out of places of danger to safety. The workman's attitude will depend upon his attitude, and he can interest his men in safety by studying their jobs and giving specific instructions as to the safe methods of work. When the job is finally laid out, with first class equipment at hand, there should be few accidents. Provided, of course, that the men assigned to the job are suited to the work, properly instructed in their tasks and responsibilities, and have firmly in mind the proper sense of safety discipline. Natural awkwardness, timidity, and absent-mindedness are to be feared equally with bad habits and recklessness."

Porto Rico Gets Rate Increase

San Juan, P. R.—The Department of Commerce reports the increase in telephone rates for Porto Rico has been authorized, beginning May 1, and as a result of the $60,000 additional annual income which they expect to receive, the Porto Rico Telephone Co. plans numerous extensions and improvements in the telephone service all over the island. The action of the Public Service Commission was taken at the request of the company, the latter finding that additional revenue was required to cover the improvements in equipment, wage increases and the setting aside of funds to meet property depreciation. The new rates are distributed in a graduated increase over the four telephone zones of the island and the different types of service. No increase in long distance call tolls is contemplated.

Chatfield, Minn.—Peoples Telephone Co. has been bought by the Tri-State Tel. & Tel. Co.

Avon Park, Tex.—Inter-County Tel. & Tel. Co. to build $20,000 exchange building here.

You can get out of cords only what's put into them

That's why Runzel-Lenz goes to the furthest extreme in its testing of raw materials. We know that by putting only the best of everything into our cords you are sure to get the best of service out of them.

RUNZEL-LENZ uses only expert labor, a good part of it from veteran specialists in cord making and only the best methods that our more than a quarter of a century experience has approved as the most modern, practical manufacturing developments.

And as the one fitting companion factor for this combination of superior labor and methods our laboratory keeps constantly busy thoroughly testing each shipment of raw material, and the finished product, so you may be certain to get the cords of longest life, finest transmission and easiest handling when your cord orders read "Runzel-Lenz."

Standardize on Runzel-Lenz cords and note the decided improvements in serving and saving.

RUNZEL-LENZ ELECTRIC MFG. CO.

Specialists in the Making of All Types of Telephone Cords

1751 N. Western Ave. CHICAGO, ILL.

Common Sense and Telephone Finance

By CHARLES W. McKAY, M. E.*

Tradition has it that "talk is cheap." Yes, talk may be cheap—or it may be expensive, very expensive, if it is the wrong kind of "talk"; sponsored by apparently well-meaning people and so disguised as to resemble "sound advice."

Take the question of telephone financing, for instance—and the everlasting flow of suggestions as to what the telephone man should, or should not, do with his property.

My personal experience in the Independent telephone field has extended over a good many years—and I have yet to meet the owner, or manager, of a small (or large) telephone property who is so lacking in common sense and so deficient in the fundamentals of modern business that he needs a nurse to guide him through the "intricate maze" of modern telephone financing.

Frankly, I think this perpetual harping upon the dangers of selling, or consolidating, telephone properties is an insult to the intelligence of the Independent telephone man. He is not given to buying gold bricks from strangers or indulging in wild cat stock selling schemes. So why keep telling him to beware of every stranger who wants to buy his most cherished possession—the business by which he makes his living, the telephone business.

If Independent telephone men were "boobs" Independent telephony would have died a natural death many years ago.

Association Warnings

I will admit, however, that a period of "frenzied telephone finance" threatened (I use the word "threatened" advisedly) the Independent telephone industry some months ago and that state and national associations did well to give this subject their careful consideration and advise the member companies as to their findings.

The national and state telephone associations have again and again proven their worth. Quite naturally, then, their advisory communications are worthy of the most careful consideration on the part of the Independent telephone industry at large.

But let us pause for a moment and consider what the average telephone man would be apt to do when approached by an investment banker—with a seemingly tempting offer for his property—a property which, in many cases, represents a life work on the part of the aforementioned average Independent telephone manager.

It's not poor policy to hear both sides of every question. Selling, new financing and merging are in the spotlight in the Independent telephone field now and before company heads decide upon their action complete consideration must be given to every side of the proposed deal.

Mr. McKay, who is well known as a telephone engineer, writes on the subject of telephone finance as one who is also well acquainted with the point of view of the reputable financial houses.

In the first place—the Independent telephone industry has *not* been developed by harum scarum individuals entirely devoid of a sense of their responsibility to the public. The very nature of the public utility business (and most especially the telephone bsuiness) imposes great responsibilities upon the owners and managers of utility properties.

True, the Independent telephone manager is not in business for pleasure—but he realizes that the very nature of his business imposes certain public responsibilities upon him. If he did not fully appreciate these responsibilities he would not be where he is today. The swindlers a..d "property-bleeders" have long since been eliminated from the Independent telephone field by the simple process of the survival of the fittest. The same general remarks may apply to the lackwits who need a nurse to guide their footsteps in connection with the administration of their respective properties.

So, when an Independent telephone manager is approached by the representative of an investment banking house, he naturally gets a "line" on the house in question. This he can easily do through local bankers who always have a means of direct communication with the larger towns and cities in which most of the investment banking houses are located.

Bankers' Stake

In connection with the foregoing it should also be remembered that a reputable investment banker has far more at stake (insofar as the maintenance of his integrity is concerned) than the telephone man to whom he is talking regarding a possible purchase and sale; refinancing; a merger or a bond issue. Where the telephone company is dealing in tens or hundreds of thousands, most of the larger public utility bankers are dealing in millions—in connection with the various projects they have on hand at any given date. Furthermore, the investment banker has his clientele to protect. This clientele may consist of retail customers or wholesale jobbing to banks and institutions—or both.

Why then should the investment banker jeopardize his standing for a few paltry thousands? Again, why should he wish to launch into a business regarding which he knows nothing? The answer is obvious. If a reputable investment banking house approaches you with a proposition it is bound to be a legitimate one. If he wants to buy your property you may be sure that he has, associated with him, practical telephone men who are able to carry on the business. Otherwise he would simply be jeopardizing his own funds—as well as his reputation.

Need for Financing

Approaching the question from another angle, there is a real need for financing in the Independent telephone field and ofttimes local bankers are unable to take care of this need. The Bell system, as we all know, is amply provided for with respect to its financial requirements. Reputable and willing investment banking houses can take the place of the Bell financing department in the field of Independent telephony.

I may be wrong, but it seems to me that reputable bankers who are interested in the telephone field should be accorded every courtesy and treated with confidence—not with an air of skepticism. From personal knowledge, I know that five or six years ago Independent telephony incurred very serious difficulties in attempting to interest reputable financial backers. Investment houses would listen to electric light and power propositions and at the same time turn down a very good telephone proposition. Now that these investment houses have come to appreciate the possibilities in the Independent telephone field, why discourage them?

Now let us look at the problem from

*Consulting Telephone Engineer, 448 Wrigley Bldg., Chicago, Ill.

the standpoint of the maintenance of small isolated telephone property units. Unless these units are closely allied through the medium of mutual understanding and equitable working arrangements—is it not true that they can be operated more efficiently and more economically through the medium of a merger into a moderate sized unit. The overhead expenses can be reduced; operating expenses can be reduced; buying power (from manufacturers and dealers) can be increased—to say nothing of the manifold benefits derived by the telephone subscribing public. In the long run the earnings will be increased and the stockholders correspondingly benefited.

There is one point, however, which we must all keep in mind in dealing with investment bankers—and that is the subject of depreciation. With the very best of intentions, the investment banker may be inclined to "skimp" a little in his allowance for annual depreciation. The reason for this is obvious. He is not an operating telephone man and he does not understand the depreciation requirements as you, an operating executive, do.

If you are considering approaching an investment banker with respect to the sale of your property; the merger of your property with other desirable properties, or the issuance of securities—the writer would suggest that you assemble the information with respect to your own property along the general lines suggested in the accompanying outline.

In addition to the information suggested in the foregoing outline, you should of course have an appraisal and audit of your property made by disinterested parties—whose reputation is such as to merit the confidence of the investment bankers.

In conclusion I most certainly do not wish to leave the impression that I am in any way criticising the activities of the national and state associations. These bodies, in the main, are splendidly organized; know what they are doing and are fully competent to advise the member companies. I do wish, however, to present the subject in a little different manner (and it seems to me a manner more equitable to all concerned) than it has been presented by many during the past six or eight months.

Long Distance Connection Between Mexico City and San Luis Potosi

Mexico City—The Mexico City-San Luis Potosi line, a distance of 525 kilometers, was opened in February. This is an extension of the service between Mexico and Queratarо, which was inaugurated several months ago by the Cia. Telefonica y Telegrafica Mexicana. The company is now working on the section between San Luis Potosi and Tampico, and by the end of this year it is hoped to connect Mexico City with Laredo.

Information Required in Connection with the Purchase, Sale or Refinancing of Operating Telephone Properties.

1. THE PROPERTY.
   - (a) Exact corporate title to property.
   - (b) Location of property.
   - (c) Officers.
   - (d) Is this property controlled or leased by another company; if so, give name.
2. COPIES OF FRANCHISES.
   - (a) Amendments thereto.
   - (b) Does company operate under indeterminate permits?
3. REGULATION.
   - (a) State if a local body, state commission, or interstate commerce commission regulates the property.
   - (b) Give name and address of such body.
4. COMPETITION.
   - (a) State if competition exists, and if so, give name and address of competing company.
5. TYPES OF BUSINESS SERVED.
   - (a) Local.
   - (b) Long distance.
   - (c) Rural.
6. DESCRIPTION OF TERRITORY SERVED.
   - (a) Population (either U. S. census or special state, county, city census).
   - (b) Nationalities.
   - (c) List of principal industries in territory served with approximate number of employees in each.
   - (d) Number of houses in territory served.
   - (e) Railway and transportation facilities:
   - (f) Municipal improvements such as: paving, lighting systems, public buildings, etc.
7. DESCRIPTION OF PROPERTY OWNED.
   - (a) Give capacity of plant and substations; list the equipment therein.
   - (b) Number of poles.
   - (c) Miles and types of lines.
   - (d) Real estate owned.
   - (e) List of buildings owned.
   - (f) Right-of-way (if easement is term limited or perpetual, and what are restrictions, if any?).
   - (g) Give general statement as to age and condition of property.
8. NUMBER OF CUSTOMERS.
   - (a) Urban.
   - (b) Rural.
   - (c) Miscellaneous.
   - (d) Statement as to number of residential and number of commercial customers.
9. RATE OF SCHEDULE.
   - (a) This should cover all classes and services rendered.
   - (b) Copies of large or special contracts.
   - (c) Copies of all municipal contracts.
10. AVAILABLE BUSINESS.
    - (a) Percentage of business available with present equipment.
    - (b) Percentage of business available upon making additional improvements.
    - (c) Possible business in contiguous territory by extension of lines.
11. CONSTRUCTION EXPENDITURES NECESSARY.
    - (a) For rehabilitation.
    - (b) For new business.
12. FUTURE OUTLOOK OF TERRITORY AND BUSINESS.
13. BALANCE SHEET.
    - (a) Last available complete balance sheet, this should contain an analysis of all corporate securities, authorized or outstanding.
    - (b) Analysis of plant and property account.
    - (c) Analysis of officers' and directors' salaries.
14. EARNING STATEMENT.
    - (a) Comparative statements by years for similar twelve months periods. Last twelve month period should be used.
    - (b) "Net earnings from operations" should be after deductions of any and all expense items, with the exception of dividends, interest or depreciations.
15. EMPLOYEES.
    - (a) Number.
    - (b) Union or non-union.
    - (c) Analysis of pay roll, dividing employees into classes and rates of pay.
    - (d) General statement of labor conditions and supply of labor.
16. PUBLIC RELATIONS.
    - (a) Consumers' attitude toward company.
    - (b) Rate controversies existing.
    - (c) Is general service satisfactory?
17. POLITICAL RELATIONS.
    - (a) Attitude of Mayor and City Council.
    - (b) Is general service to city satisfactory as to both rates and service?
    - (c) Have utility issues been presented in any election?
18. LEGAL.
    - (a) General statement as to existing lawsuits.
    - (b) Have damages been assessed against the Company?
    - (c) Condition of titles.
    - (d) Certified copy of the company's charter certified to by the Secretary of State of the State under whose laws the company is organized.
    - (e) Certified copy of the by-laws certified to by the secretary of the company.
    - (f) Complete information as to all franchises held by the company, together with copies thereof.
    - (g) Abstracts covering the real estate owned by the company brought down to date. It might be wise to have the abstracts submitted in their present condition with the understanding that we will examine and have them brought down to date.
    - (h) A certificate of the secretary of the company as to the number of shares of each class of stock outstanding.
19. TAXES.
    - (a) Valuation assessed.
    - (b) Rate and amount of taxes.
20. PHOTOGRAPHS AND MAPS.
    - (a) Attach maps of lines and land owned.
    - (b) Photographs of plant and properties.
    - (c) Photographs of principal public buildings, factories, etc.
    - (d) Telephone Directory.
21. RECOMMENDATIONS REGARDING OPERATIONS.
    - (a) Reconstruction.
    - (b) Extensions.
    - (c) Operations.
    - (d) Cost of changes.
    - (e) Prospects of the surrounding community; prospects of the future business.
22. SALES PRICE OR FINANCIAL REQUIREMENTS.

Cresoted Pine Preservation and Service Characteristics

By E. E. BOEHNE*

Undoubtedly some of the companies represented in this audience are using creosoted pine poles in their lines now, who were not using them two or three years ago. That condition is almost national in its scope. The use of creosoted pine poles, according to government statics, increased 500% between 1920 and 1925. Five hundred thousand were installed in 1923. That number increased to a million in 1924. What makes this latter fact particularly outstanding is that it was the only species of pole that materially increased during that period.

Obviously there is represented here a very definite swing of the industry.

When utilities, that had not considered creosoted pine poles before, began to study them intensively, the creosoting industry found it necessary to put its information on the subject in readily available form, and to improve the means of disseminating it. This paper is a part of that effort.

Why should you be interested in the comparative value of poles? What makes a difference in their worth to the utility company?

In a word, a pole's worth is measured by the length of time it gives satisfactory life in the line. What shortens that life in the great majority of cases, is decay. Decay then, and its prevention (which is preservative treatment) are prime points for consideration, and these points are reviewed briefly, along with a more detailed discussion of the creosoted pine pole's characteristics in service.

Fighting Decay

Decay in wood is caused by low forms of plants called fungi; and by bacteria. Through the secretion of little understood chemicals, they dissolve the wood fiber, and its substance serves as food for the fungus. The science of timber preservation consists in poisoning that food (the wood). Creosote is the poison. The operation of injecting it deeply into the wood by pressure is the work of the modern wood preserving plant.

There are other wood preservatives, but creosote is by far the best known. The highest grade that can be used, and the only grade that should be used is that which complies with the specifications of the American Wood Preservers' Association and the American Railway Engineering Association.

The first step in the creosoting of pine poles, or rather a step preliminary to their treatment, is to "season" them, that is, to remove a sufficient amount of the moisture which all freshly cut wood contains to permit the entrance of the creosote. This is accomplished either by allowing the wood to dry on a seasoning yard, or by steaming it in the treating cylinders.

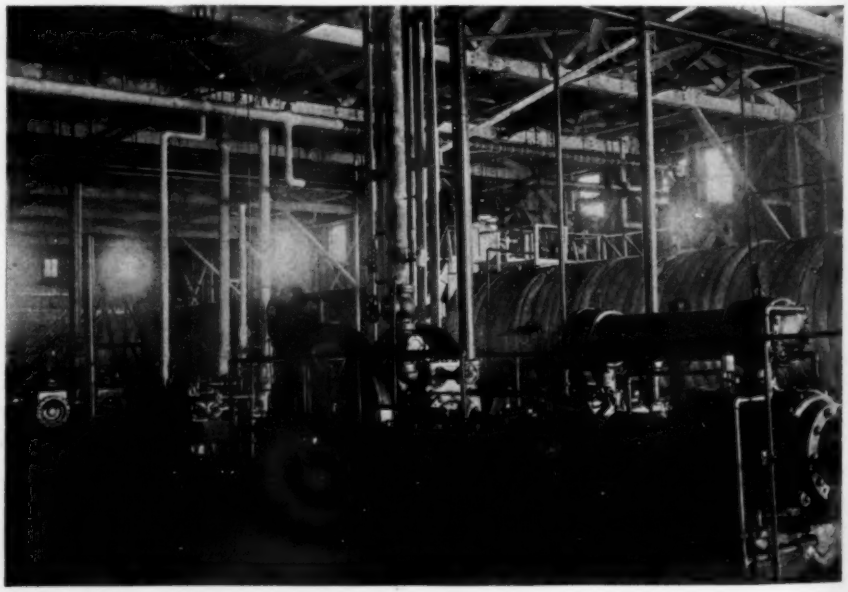
Two processes have recognized standing and are in general use for pole treatment. They are the Bethel process, using 12 pounds of creosote per cubic foot of wood, and leaving the wood-cells full of creosote after treatment; and the Rueping process retaining 8 pounds of creosote per cubic foot and leaving the wood-cells partially empty after treatment.

In the Bethel process, after the material is placed in the cylinder, a vacuum of about 24 inches is maintained until the wood is as dry and free from air as practicable and then, without first breaking the vacuum, the cylinder is completely filled with the creosote oil. After the retort is filled, additional creosote is forced into the cylinder by means of pressure pumps, the pressure being gradually raised to and maintained at not less than 125 pounds per square inch at a temperature of 180 to 200 degrees F., until the required amount of the preservative has been forced into the wood. The pressure is then released, the oil drained from the cylinder and another vacuum drawn. The object of this final vacuum is to remove the surplus creosote from the surface of the timber, thus making the wood dryer on the surface and cleaner to handle.

In the Rueping process, as the first step, air is pumped into the cylinder and thus into the wood under high pressure; then while this air pressure is maintained the cylinder is filled with creosote. As the oil enters, the air is gradually released, but without allowing the pressure to drop. In this way the cylinder is filled with oil, and a considerable quantity of air is entrapped in the wood at the same time. More oil is then pumped in and the pressure is increased. After the maximum quantity of creosote has been injected the pressure is released, the oil drained from the cylinder, and a final vacuum applied. This reduction in pressure allows the air entrapped in the wood to expand and force out much of the oil originally injected, leaving partially empty wood cells. The initial injection on 8-pound Rueping treatment averages 16 to 20 pounds of creosote per cubic foot of wood.

Penetration Is Measure

Pine, of all the commercial species, is the most susceptible to preservative treatment. In a given cylinder charge, creosote applied as just described, penetrates



It takes plenty of equipment to treat pine poles. The cylinder shown in the background is one of the largest in the wood preserving industry. It is 164 *feet long, and* 9½ *feet in diameter. Note the large pumps required to serve it*

This is an address delivered before the Missouri Association of Public Utilities by E. E. Boehne, sales manager of the International Creosoting and Construction company.

many poles throughout. Deep penetration is an all important factor for it is practically a direct measure of the value of treatment—this because any kind of wood will check and once the checks extend in beyond the creosoted layer, untreated wood is exposed to decay and insect attack. Deep creosote penetration, therefore, is a first essential to good pole treatment.

So much for the cause of decay and its prevention by chemical preservation.

If the question were asked—"What is the outstanding feature in the service of creosoted pine poles?" this would be the answer, "They have the longest life of any kind of wooden pole and during that life their strength remains practically undiminished."

The strength of pine is outstanding in that it is the highest, the most permanent and the most uniform of any of the pole woods. Exhaustive government tests show its modulus of rupture to be over thirty per cent greater than the nearest other pole species. What is almost as important is that fifteen or twenty years after installation that strength is no less than when the poles first went into the line. Recently the American Telephone & Telegraph Co. tested sound creosoted pine poles twenty-seven years old and found them practically as strong as new.

As to uniformity, the Bureau of Standards after studying the plotted results of the load-in-pounds at which hundreds of test poles broke, pointed out that the strength of individual poles in the southern yellow pine group departed less from the average than any of the other species. That is, pine's strength is the most uniform.

In line construction practical advantage is taken of the above facts in one of two ways—either by using smaller poles or by using longer spans.

Life

The life of creosoted pine poles is not known. The oldest installations are still in use; their present condition is good and there is nothing to indicate how much longer they will last. Several lines, cited below, for which records are available, show less than 10% renewals in 25 to 30 years. In many lines 10 to 20 years old it has not been necessary to replace a pole. The remarkable thing is that these very old poles are still in apparently splendid condition. An increment boring taken at the ground line on a 25-year-old pole is of such appearance that if placed in a group of borings from creosoted poles just from the treating cylinder it could not be distinguished.

Various published estimates of the life to expect are:

Pennsylvania Electric Association—35 years.

Graybar Electric Co. (full cell treatment)—40 years.

From "Notes on Wood Preservation and Utilization in Europe" by George M. Hunt, Forest Products Laboratory. "The life of full-cell treated pine poles in England was understood to be from 30 to 40 years" . . . "There are said to be 40,000 creosoted power line poles in southern France which are over 20 years old and have not yet reached their average life."

A few lines that have given long service are:

Oklahoma Railway Co., 200 poles installed 1908. No replacements to date.

Southwestern Bell Telephone Co., Dallas to Sherman, Texas, installed 1909 50 miles in length. No replacements to date.

American Telephone & Telegraph Co., Washington, D. C., to Norfolk, Va., installed 1897, 90% of poles unaffected by decay, according to most recent A. T. & T. inspection report.

Lake Charles Railway Light & Water Works, Lake Charles, La. Poles for city service installed 1899, 1% replacements to date.

Beaumont-Port Arthur, Texas Interurban line. Six hundred and ninety-two poles. Line installed 1912. To date three poles replaced (mechanical causes; not decay).

Termites or White Ants

The attack of white ants on poles is becoming an increasingly vexing problem. Once they gain entrance to a pole, nothing can stop them. An investigator for Stone & Webster has just published his discovery of white ant attacks in disturbing numbers in New England states. The Western Union Telegraph Co. conducting studies on its own lines only a year ago learned to its surprise that white ant attack on poles was occurring in the states of New York, Pennsylvania, and Illinois. Here is a paragraph from a paper by the Western Union construction engineer who has been studying this problem:

"It appears that attack by termites is so serious in southern California that in order to secure a satisfactory life, it may be necessary to employ only poles that have been treated the full length. But termite attack is not limited to southern California. We are finding that a great many of the poles which we replace, in various parts of the country, have been more or less riddled by borers at and below the ground line. Evidently this condition is becoming widespread throughout the country, and poles are deteriorating much faster than by decay alone." . . .and quoting further . . ."I have stressed this matter of insect attack because I believe it a subject of great importance."

The white ant problem is serious. Any pole using utility may well study it. The status of creosoted pine poles, with regard to white ant attack, is covered by the statement quoted below from government bulletin No. 1231 "Tests of Methods of Protecting Woods Against Termites or White Ants." The bulletin says:

"The most effective preservative in protecting timber to be set in the ground from attacks by termites is coal-tar creosote . . . Impregnation by the full cell process with coal-tar creosote renders wood resistant for at least 25 years."

To touch briefly on two or three further points: There is the matter of conductivity—whether creosote effects the resistance of wood to the passage of current. This problem belongs to the electrical engineering field rather than to the field of wood preservation, and the conclusions of engineering committees that have studied it are quoted as follows:

Summary of Southwestern Bell Report, 1924:

"The question is sometimes raised as to whether untreated poles are more suitable than treated poles for joint use with electric companies. This bulletin indicates that pole resistances are lowest when the pole surfaces are wet and that under these conditions the resistances of treated and untreated poles are approximately the same. For these reasons, it is felt that as far as safe operating conditions and safety to linemen are concerned, treated poles are as satisfactory for jointly used lines as untreated poles."

Summary from American Wood Preservers' Association Conductivity Committee 1923:

"Poles—Your Committee has decided that for all practical purposes the conductivity question as related to poles holds no interest for the following reasons:

"1. The distribution engineer is concerned with insulator and crossarm resistance, the pole resistance forming but a small fraction of the circuit to the ground.

"2. Creosote is the preservative in general use for pole preservation, and the experimental data show that it increases resistivity of timber.

"3. Steel poles and crossarms are in common use on transmission lines."

In times past and occasionally even now the question is raised as to use of creosoted pine poles on busy city streets. Some objection has been raised on the basis that their oily surface will damage the clothing of people who might come in contact with them.

With the advent of the Rueping empty cell process, this objection has been largely eliminated. The science of wood preservation, like other sciences, has advanced greatly during recent years and with the better knowledge of timber seasoning methods, of creosote, and of treatment, the creosoted pine pole, particularly when treated by the Rueping process, has but little objection on this score. Comparatively speaking, it is a clean pole. Hundreds of cities are using them on busy streets. A few examples (citing one city for each of several states) are Brooklyn, N. Y.; Detroit, Mich.; St. Louis, Mo.; Dallas, Tex.; Wichita, Kan.; Lincoln, Neb.; Des Moines, Iowa; Springfield, Ill.; Raleigh, N. C.; Ft. Wayne, Ind.; Oklahoma City, Okla.; New Orleans, La.; Atlanta, Ga.; Los Angeles, Cal.; Memphis, Tenn.; Little Rock, Ark.; Greenville, S. C.; Bowling Green, Ky.; Akron, Ohio.

The foregoing has touched but briefly on the more important characteristics of the creosoted pine pole, with relation to its service in the line. In so brief a

Easy to See Why the
UNIQUE FURNACE
is preferred

PATENTED ARRANGEMENT FOR DISLODGING COIL WITHOUT TEARING DOWN FURNACE
PATENTED SEAMLESS TUBING COIL GENERATOR
IMPROVED ONE PIECE BURNER
HAND HOLD FOR CLEANER ONE TURN CLEANS ORIFICE
AUTOMATIC ORIFICE CLEANER
16 GUAGE STEEL TANK WELDED BOTTOM
AUTOMATIC PUMP INSIDE TANK

Many of the foremost Bell and Independent companies have standardized the Unique Furnace. It melts 50 lbs. of lead in 10 minutes. An automatic orifice cleaner assures continuously efficient operation. It's sturdy and simple.

"UNINTERRUPTED SERVICE"—the result of a "UNIQUE DESIGN and BETTER CONSTRUCTION."

Literature ready—BLOW TORCH and Furnace.

UNIQUE MFG. CO.
113 N. Des Plaines St. Chicago
CHOICE OF THE LEADERS

Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	2,200 lbs.
6" 4-way	6,000 lbs.
8" 2-way	6,000 lbs.
8" 4-way	10,000 lbs.
10" 4-way	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

CHOICE NORTHERN
WHITE CEDAR POLES
LET US SERVE YOU ALSO
REPUBLIC CEDAR CO.
MARINETTE WISCONSIN

paper many minor points, though worthy of consideration, must be omitted.

But one vital point with regard to buying: Creosoted pine poles do differ in quality. They all look black on the surface, yet the service in your line depends on what is beneath the surface—the soundness of the timber, the quantity and quality of the creosote, and the thoroughness of the treatment. Price considered alone—the blind worship of the low bid, is suicidal to pole service.

One of the outstanding developments in modern pole business has been the substitution of a quality or a service motive for the price motive in buying.

"YOU'LL BE AN ARTIST"

"Did you get your trouble, kid?" asked the old timer of the youngster who was pridefully logging the clearance of one of the few cases which he had been permitted to handle unaided.

"You bet I got it," replied the boy, his face aglow. "Some one had thrown about six feet of old rusty dog chain in the line. Missed it six poles, Old Timer. How's that?"

"Oh, that's fair, son—just fair. You don't want to get yourself all prided up over it. Next one—maybe you'll miss it a mile."

"I remember back in 1913," continued the O. T. "I ran ten cases under ten poles error in three weeks straight runnin' and the very next case I subtracted when I should have added and sent Jenkins the wrong way about ten miles. Sam called in after I finally got him turned about and he'd cleared the trouble, and what he told me about my testin' ability is still strong in my mind.

"But it's like that. Sometimes your testin' curve will be up and next time down. Sorta like a lineman's job. But that's part of the game—the tussle with yourself to make a record for skill, to become a real artisan and then hold your reputation. It means somethin', son, the confidence of Sam Jenkins, Hughert, Kram, McGinnis—that means somethin'. When they hear you on the line tellin' 'em where the trouble measures, they know nine times out of ten it'll be within twenty poles of there and they go after it plumb full of cheer and the feelin' of pride of workin' with you.

"Back in 1910, Rush measured a swingin' ground on 1-4 Chicago-Omaha line. It measured eleven miles east of Fort Des Moines. But before the Fort Des Moines section lineman got there it'd cleared out. Next day at the same time the same thing happened, a quick swingin' ground. Rush sent Jerry Welch out on it. As before, it cleared out before Jerry reached it. Rush began to doubt himself, but Jerry didn't doubt him. They talked it over and agreed that Jerry should be out there ahead of time next day.

"As he drove down the road at 10:30 next mornin' past the pole Rush had given him, he looked down the line. About eleven poles ahead of him the kids of a country school were out in the school yard with a piece of iron wire hooked over number one, very busy touchin' the other end to the pump, which was just a little to one side of the line. When they first put the wire on to the pump they got nice fat sparks. Then the Morse was moved and no more sparks. Then they laid their wire away for another recess.

"Jerry Welch right there demonstrated the versatility of a good section lineman. He went to school after recess and with Teacher's permission made a speech to the kids which I 'spose has made them better citizens. Anyway, they didn't do any more Ben Franklins with the line. That pair was a Denver circuit in those days, boy, and that meant about what a San Francisco circuit means today. When you find the lineman askin' for you by your first name you'll know that you're there on open wire testin', son. Then you can begin to learn somethin' about measurin' troubles in cables. And when you get so your boss has confidence in your ability on cables, then you're an artist, son. More than that, you'll be a real artist, I'll say."—Linis Knott Noan in *Long Lines*.

PASSING OF THE "BOOMER" LINEMAN

I remember the lineman called "boomer"
When the finding jobs wasn't hard,
Who never denied any rumor
That he carried a journeyman card.

In the spring we watched for his coming
With that rollicking lineman's stride;
With his clothes rolled up for a bumming
And tools that were surely his pride.

As a lineman he was a past master
And, always, he wore a stiff hat.
Some young men might climb a bit faster,
But few ever passed him, at that.

On dangerous work, not a fumble;
He could show us a trick or two;
Long days never caused him to grumble,
If the overtime pay would come through.

Sometimes he would work all the season,
But often, around his first pay,
He would cook up some outlandish reason
For leaving, and be on his way.

The home guards, of course, started kicking
And that often threatened a war,
So managers favored men sticking
And the boomer lineman's no more.

—Ray Blain.

Speculators Are Blistered at New York State Meeting

Rochester, N. Y.—Again the interests that plan purchase of telephone properties for speculative purposes instead of for conservative and legitimate financing and expert operation were given a raking over the coals when a well attended meeting of the Up-State Telephone Association of New York heard J. G. Ihmsen, its president and general manager, and President MacKinnon of the national Independent association speak on the current wave of telephone financing.

"The inevitable reaction will come where this financing has not been done on a sound and conservative basis," said Mr. MacKinnon. He asked his hearers what they would do with 50 small companies to make them earn on their cost, in outlining the problems that confront those refinancing and merging telephone properties. He stated that of the 52 class A Independents only two had changed hands; of the class B companies, little change; some changes in the class C companies, but many among the class D Independent enterprises. The Independent chief recommended that Independent companies educate their home bankers in telephone securities. He detailed some of the tricks of the trade practiced by the security houses that were new to the telephone business and not above depending unduly on hope instead of some more substantial business consideration.

Association Helps Members

Mr. Ihmsen, who was re-elected with all the rest of the state's ticket, told of the successful developments of the organization's campaign to better the operation and profits of the state's smaller properties. He commented that improvement in plant, traffic and commercial conditions was noticeable and that there was a favorable change in the attitude of managers and operators.

The eight district meetings held during the past year by the organization also were productive, said the Up-State head. There were many practical addresses on the program, starting with the talk of P. L. Johnson, general plant manager of the New York Telephone Co., Albany, on "The Plant Job Today." He cited the necessity of long-distance communication standards in even the out-of-the-way places today, and of reliability in construction. To meet the new conditions he told his hearers to develop more efficient construction and maintenance methods; improve performance along the lines that react directly on the subscriber to the end that better service is given from the subscriber's point of view, and to train employees so they will be able to carry out company wishes cheerfully in the above mentioned respects.

Accounting Is Covered

Ward Hinman, telephone engineer of the New York Public Service Commission, talked on "A Plant Accounting System for Small Companies," and explained the system he has devised. This system is based on forms consisting of a daily labor report, material report, labor distribution summary, material and supplies summary, and payroll and distribution. The big feature of this system is that it can be handled day by day by a clerk already employed.

Following the presentation of the Hinman address there was a lively discussion in which Frank J. Brookman, vice-president of the Rochester Telephone Corp., took a leading part and gave some suggestions for bookkeeping for the smaller companies. He told of what steps were necessary in a small company changing its methods from the cash basis so the true financial status of the company could be determined on any given date. He also spoke of the depreciation reserve methods that would be most practical for the smaller companies. His comments were of an exceedingly practical and valuable character.

"Salary Allotment Insurance" was the subject on which G. V. Kuehner of the Travelers' Insurance Co. talked. He told of seven out of eight men leaving no other estate than insurance, and in view of this condition how the plan of insurance he described worked out for utility companies. He related the experience of the Rochester corporation with salary allotment insurance. The plan met with favor among the telephone companies represented and the association is considering submitting such a plan to all member companies.

"Telephone Directory Advertising as a Valuable By-product" was the topic covered by Frank T. Byrne, commercial superintendent, of Rochester. He detailed the methods of effective directory advertising solicitation.

A safety session during which Robert M. Bruce of Rochester and Walter M. Hughes of the gas and electric company of that city spoke, was one of the interesting features of the convention. G. G. W. Green, general manager at Johnston, told the convention some methods of increasing pay station business by good advertising, keeping the booths clean, and good lighting. Joseph Lillich, statistician, Rochester Telephone Corp., spoke on "Preparation of a Forecast of Operating Revenue," showing a number of slides to bring out his points.

Pay Tribute to Fuller

In formal session and in the gossip around the lobby and in the manufacturers' exhibits the convention paid high tribute to the memory of the late George R. Fuller, long one of the leaders of the association. Herbert W. Bramley, an associate of the lamented New York chieftain, made the formal memorial address.

During the convention a well attended and valuable operators' conference was held during which a number of the commercial experts of the state spoke.

Stromberg-Carlson and Kellogg entertained the men and women who attended the convention at luncheons and a theater party. The usual big and lively banquet was staged during the annual conclave.

To Reach the Man
Who Does the Buying
Advertise
in
TELEPHONE
ENGINEER

Public Utility Financing

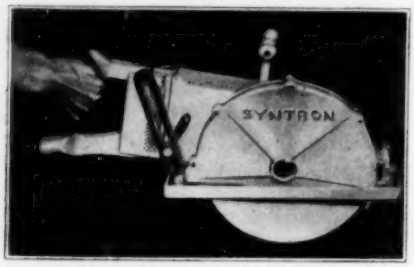
P. W. CHAPMAN & CO. INC

170 W. Monroe St. Chicago
42 Cedar Street New York

Boston Albany St. Louis Milwaukee Grand Rapids
New Orleans Seattle Portland San Francisco

Syntron Introduces Portable Electric Hand Saw

Pittsburgh, Pa.—The Syntron company has just announced the addition of a new product to its line, namely, the Syntron portable electric hand saw. A big feature of this saw is the 99 per cent safety guard with which it is equipped. This guard is of telescopic construction and swings back exposing the blade as the cut progresses. When this saw is removed from the cut the guard instantly and completely covers the spinning



blade, insuring absolute protection for the operator. The saw is equipped with a large show made of heat treated aluminum alloy, which entirely prevents the saw balde from weaving, and when used upright on progressive cutting, completely eliminates rocking and tipping and holds the blade true to the line without wrist strain. The shoe can be quickly adjusted to make any depth cut from one-eighth to 4 inches. This feature makes the saw especially adaptable for cutting out flooring, panels, etc.

The motor which drives the saw is a powerful universal, which operates on either 110-volt alternating or direct current. It can also be supplied for 220-volt current. The drive is an extremely efficient worm and gear. It is fully equipped with Timken roller bearings throughout, assuring a quiet and powerful driving of the saw blade. The blade runs at a speed of 2,400 r.p.m., no load, and at 1,800 r.p.m. normal full load. The cooling system, in addition to keeping the saw cool, blows away the sawdust so that the cutting line is always in clear view.

This saw also operates special blades for mitering, etc., cutting fibre, plasterboard, bakelite, sheet lead, marble, hard rubber, brass and other similar materials.

Dimensions are as follows: Length, 22 inches; height, 12 inches; width, 7 inches; net weight, 31 pounds; diameter of blade, 11 inches.

The Syntron portable electric saw will rip 2-inch oak lumber 420 square inches per minute and cross-cut 3-inch oak lumber 300 square inches per minute. It is said to be 40 per cent more powerful than any other saw of the same size.

Nazareth, Pa.—Slate Belt Telephone Co. bought by Lehigh Telephone Co.

Stromberg-Carlson Is Licensed Under Radio Corporation Patents

Rochester, N. Y.—As a result of negotiations concluded between David Sarnoff, vice-president and general manager of the Radio Corporation of America, and W. Roy McCanne, president of the Stromberg-Carlson Telephone Mfg. Co., the Stromberg-Carlson company, which has been making high grade telephone apparatus for 35 years and high grade radio apparatus for the past 12 years, becomes a licensee under 140 or more radio patents of the Radio Corporation of America, the General Electric Co., the Westinghouse Electric & Manufacturing Co., and the American Telephone & Telegraph Co.

Mr. McCanne stated:

"The Stromberg-Carlson company's policy has always been one of providing complete patent protection for its users and its dealers. In keeping with this policy it has sought licenses under all valid radio patents necessary in the manufacture of its equipment and is now in the enviable position of being the only manufacturer having rights to operate under the patents of the Radio Corporation of America and its associated companies and also under the patents of the Hazeltine corporation, the Latour corporation and the Radio Frequency Laboratories, Inc.

"The right to use the inventions disclosed in these four groups of patents affords the Stromberg-Carlson company complete freedom of action in design and manufacture and clears up all likelihood of its users and its dealers being involved in future patent litigation. We plan to continue making the same balanced, selective, high grade receiving set as heretofore, embodying the use of both Radio Corporation patents and the Hazeltine-Latour patents."

Western Electric Has New Works Shop

Chicago, Ill.—The Western Electric Co. announces the organization of a new manufacturing branch at its Hawthorne works in Chicago to be known as the specialty products shop. Among its many functions are the building of microphones, vitaphone parts, audiphones, telegraph and railroad signalling apparatus, test sets and telephone heating coil elements.

Jay W. Skinkle, formerly signalling sales manager of the Graybar Electric Co., has been appointed superintendent of this new branch.

The effect of the change is to create at the Chicago plant a manufacturing organization with complete machine equipment for the production of special apparatus in relatively small quantities. Work of this character has previously been carried on in jobbing departments which will now become a part of this new organization.

Bernz Puts Two New Furnaces on Market

Newark, N. J.—Otto Bernz Co., Inc., has started to manufacture two new style gasoline furnaces which are known as No. 23 bulb and No. 24 pump.

A brief description of the ten outstanding features which are fitted to these furnaces follows:

Shield is made in one piece from heavy sheet steel.

Handle ears and top plate so made that handle will hang in horizontal position on one side of the furnace so as to hold soldering irons. To lower handle, turn to other side of furnace. (Patent applied for.)

Reservoir has funnel. Filler plug has patented "Dust Proof" cap.

Pump is the patented "Never Leak" style, which is a positive guard against leaks.

Heavy seamless drawn steel reservoir and bottom. The three extra heavy bushings at top, and the bottom are welded into place. Capacity, three-fourths gallon.

Coil cup is made in one piece from heavy sheet steel.

Uprights are made from heavy steel rod which reinforce entire furnace.

Dished steel plate keeps heat from reservoir, catches overflow from coil cup, and holds coil cup in place. Eliminates the three small nuts. (Patent applied for.)

Malleable iron plate brazed to reservoir which holds the extra heavy uprights. *Eliminates three openings at top of reservoir.* (Patent applied for.)

Handle made of coppered steel wire and fitted with two nickel-plated malleable iron ears and nickel-plated wire grip.

In addition to the features tabulated above, all brass fittings and malleable iron castings used on these furnaces are extra heavy. The coil is made of one-eighth-inch extra heavy pipe.

These furnaces are so constructed that they can be changed promptly to bulb or pump styles.

These furnaces are considerably lower in price than Bernz No. 19 bulb and No. 20 pump furnaces. The reason for placing these furnaces on the market at this time is to give the trade a bulb and pump furnace at a very close price. While these furnaces differ in several ways from Bernz No. 19 and No. 20 furnaces, they are considered good, practical articles.

Pearl City, Ill.—Pearl City Telephone Co. bought by Stephenson County Telephone Co., Freeport.

Polo (Ill.) Grows—Buys New Equipment

Polo, Ill.—The Polo Telephone Co. recently signed a contract with the Leich Electric Co., Genoa, Ill., for complete common battery central office equipment and 500 telephones to convert their present magneto telephone system to common battery.

The history of the growth of the present Polo Telephone Co. is a repetition of numerous other local plants which have continued to develop as the community made progress and became more prosperous.

Beginning as a mutual company in the early 1900's, the early record shows that a mutual organization was not capable of keeping in step with the business requirements, and in 1913 the organization was changed to a stock company.

At this same time the new management purchased a four-position Leich magneto multiple switchboard and separate toll board. The new board, because of the multiple and other features, made it possible to render far better service than was formerly possible with the transfer type of magneto equipment.

The public reaction to better service was greater demand for telephones, and the number of stations increased rapidly. The management by its established policy of rebuilding and replacement had continued to improve the plant in every department.

The present change in the system was brought about several years sooner than was originally intended and really a number of years before the traffic would increase beyond the capacity of the magneto multiple board. A change in location of the central office to newer and more suitable quarters with greater space and facilities made the time of moving especially suitable to change switchboards, and due to the rapid rate of growth it was decided to change to common battery now.

The subscribers of Polo have had the benefit of excellent telephone service in the past at very reasonable rates and with the new system the management promises service that will meet the standards of today.

Features that have the most influence on speed of operation are to be incorporated in the new equipment. Line jacks and line lamp signals are multipled in each three panels. An arrangement provides easy access to all incoming calls by any operator at the board.

Machine ringing will take care of all local calls, and perhaps is the most important feature about a switchboard in point of time saving to the operator. The ringing will be instantaneous cutoff and also under the control of the calling subscriber. Four-party harmonic signalling will be controlled by individual party line keys in each cord circuit. Emergency ringing facilities are provided.

The initial installation of the switchboard will consist of three operators' positions arranged to accommodate an ultimate of 900 lines with three-panel multiple with associated line lamps, eighty farm lines and twenty toll lines. Farm lines are terminated in lamp signals, multipled, and are so arranged that code rings are distinguishable.

The first position will handle all toll calls and has facilities for this purpose. In the face of the board are the toll line lamp signals, multiples of the local lines and rural line multiple. Five of the cord pairs are special toll circuits and ten are universal circuits. The cord circuits in the next two positions are universal. Service meters are to be installed in each position.

The power plant consists of a heavy duty storage battery of 11 cells, to be charged by a Tungar rectifier, suitable instruments and switches are provided to control the various circuits. Duplicate Leich harmonic converters will supply the ringing current.

The installation will be handled by the Leich Electric Co. and it is expected that the new plant will be cutover by October, 1927.

Western Electric Handling Vitaphone Sales

New York City.—Western Electric Co.'s subsidiary, Electrical Research Products, Inc., has taken over from the Vitaphone Corporation the handling of the sale and commercial relations of the equipment used in theaters for the reproduction of the Vitaphone. It will continue to operate from the Vitaphone company's former headquarters in the Fisk building, 57th street and Broadway, New York.

In the past the trade name Vitaphone has been used to apply both to the production and to the equipment installed in theaters. Under the arrangements recently entered into with Warner Bros. the name Vitaphone will hereafter apply to theatrical productions, while the electrical equipment by which the reproduction is made possible will be known as the Western Electric Sound Projector System.

The number of theaters equipped with this system has now passed the 100 mark and installations on existing contracts are scheduled well into the fall.

Seguin Interests Are Incorporated

Quebec, Can.—The Seguin timber interests have grown to the extent that J. J. Seguin Co. has been formed as a limited organization to handle the company affairs.

J. J. Seguin, the founder of the business, is president, and associated with him are his four sons, all of whom have been raised in the pole industry. The organization has vast acreage of its own timber and does considerable business with pole-using interests in the United States.

FOUR-LEGGED DUCT THREADER NOT INFALLIBLE

Recently one our mutual friends asked me if I remembered the little stunt that Bob Cline pulled off down in "Indianny" regarding the quickest scheme known for threading ducts. One afternoon Bob thinks to himself that some quicker and cheaper method than the orthodox manner should be devised. So did Sam Bowsher and Bill Thomas, et al., and when the brains of this triple entente started to function, the fun started.

Bob thought that a toy engine on little wheels, wound up with a spring that would run for 15 minutes placed in a duct would go through there like a streak of lightning in less than five minutes. He argued that these fool things that his kids played with ran on the floor, why not in a tile? Bill thought that it might work all right but what if it got stuck in the mud or ran into a concrete obstruction? He offered the plan of shooting a bobbin through with a shotgun, or a howitzer, or what have you. Sam, who had listened quietly to the others unfold their plans, now sits up in his chair, points his finger at them knowingly, and says they are both crazy.

Leave it to Sam to turn a perfectly peaceable Sunday school picnic into a rollicking riot. He said he had a plan all worked out that would beat theirs all over the top of the monument, and invited them to go with him. Seemed as though he had had this in mind for some time as he called George Armentrout on the telephone and told him to bring up that cage of rats and meet the party some place in Anderson, Ind. He borrowed a silk fish line off of one of the local Waltons, I've forgotten his first name, but I think it commenced with an I, and the party, including Charley Hodge lit out. They always took Charley along as he was their city slicker by heck, from Springfield, Ill., and usually had money for lunches, carfare, etc., (notice the etc.), but the trick they never got onto was just how to pry him loose from his change.

The party met, Sam tied the silk line that had cost two bucks to the rat's hind leg, shoved him in the duct, hollers "Scat," and away went the line. They then hiked to the next manhole, and lo and behold there was the rat running around the hole like mad, string and all, and the demonstration was a complete success, except that no one strained any tendons getting in this close place with a wild rat.

About the time the finishing touches of perfection were to be applied to their new scheme, Bob and Sam moved to Chicago, and they brought the idea thither, highly elated. Sam had heard that rats might be procured in the stock yards, and ordered a trap set before morning. Notice they didn't bring any of the Indianapolis rats along with them, and thereby hangs this tale. With plenty of rats caught, they sent Harry Strout over to V. A. & L.'s for fish line. He came back with enough to last him the rest of his life.

They picked out a manhole, poked the rat in, and went on to where he should be, but for some strange reason he didn't show up. So they goes back and finds only about half of the line paid out. Sam thinks to jerk it a little like a Dago organ grinder does to liven up his flea carrier, but no appreciable results followed. Now what to do. He was hesitant about pulling the rat out, as they were dangerous animals to be in such close quarters with. He found that out with the other one.

Somebody suggested a ferret, and after some delay one was found. They wanted him to chase that rat out or eat him up, they didn't care much which. But neither rat nor ferret showed up and Sam got worried. The situation was rendered all the more embarrassing by the presence of of several of the "big guns." Just before the final explosion would have taken place, a pig sticker from the packing plant nearby who had been watching the proceedings comes up to Sam. Sezze, "Say, mister, you couldn't get one of them stock yard rats to run a hundred feet in a hundred years. They won't even get out of your way."

"But what's become of the ferret?" queries Sam.

"Oh they sleep with the rats up here if they can find a nice quiet place where they won't be bothered."

Sam's glasses fell off, and for once Charley wasn't asked to buy anything.

While this Chicago ferret was not blessed with any great amount of ambition, the one that was used in Terre Haute and Indianapolis was a faithful little fellow to whom the employees all became strongly attached. After a few years of this companionship and labor the ferret caught a distemper and died in Indianapolis.

Great was the grief thereabouts, and the whole gang congregated in the supply room one Saturday p. m. to perform the last sad rites for their departed pet. The question arose concerning a disposition of the remains. They couldn't throw their little friend out in the alley or in a garbage can, no, mister, he was no common personage, so they decided upon the modern method of cremation, and secured a splicer's furnace and solder pot. You can imagine what happened when they tried to burn up a ferret in a solder pot. At this point the sacred obsequies all went blooey, and they lost most of the mourners in attendance at the first whiff.

However, Charley Johnson, Charley Sheriff Harry Meredith and Louie Miller, fought off the odor, braved the populace, cleaned up the mess, and sent the ashes or what might pass for ferret ash, up here to Bob Cline, and his grief stricken playmates. These ashes were duly placed in an urn that had formerly done service as a tobacco can, and are yet reposing peacefully in the catacombs of the twenty-one-story telephone building at 212 West Washington Street, Chicago, but Bob don't know just where, and I'm darned if I do either.—*Bell Telephone News.*

U. S. Signal Corps Orders for P. B. X. Boards

Genoa, Ill.—Contracts were awarded during the week of May 21st by the U. S. Signal Corps to the Leich Electric Co. covering the purchase of six two-position P. B. X. switchboards. The Signal Corps has adopted the two-position board as regular equipment for army posts, and is placing the new equipment in service wherever changes are to be made. The order for six is the second order placed for these boards, the initial order of ten having been supplied by the Leich Electric Co. during the past year.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.

54 Austin St., Newark, N. J.

NEW YORK **CHICAGO**

Hotel Empire

BROADWAY at SIXTY-THIRD ST.,
NEW YORK CITY

A New Fourteen Story Fireproof Structure Containing the latest in Furnishings and Equipment.

Capacity 1034

The Location is Unique in the Heart of the Automobile District, with Subway, Elevated Street Cars, Busses---all at door.

RATES

Room, Private Toilet - - -	$2.50
Single Room with Bath - -	3.50
Double Room with Bath - -	5.00

M. P. MURTHA, General Manager *Ample Parking Space*

Kearney Reduces Its Anchor Prices

St. Louis, Mo.—A reduction of prices on the complete line of malleable iron screw type anchors has been announced by the James R. Kearney Corp., 4224 Clayton avenue. Two types of anchors are now being manufactured by the Kearney corporation. The steel rod type is being made in eight different sizes, including a 6-inch anchor with ½-inch rod, up to a 10-inch anchor with a ¾-inch rod. The other line of anchors, the pipe type, has been designed for use in soft, swampy installations under water, or muck soil conditions, where the strain is over 8,000 pounds.

Features incorporated in Kearney anchors include a double eye steel rod six feet overall, a helix socket, a sharp cutting edge on the helix, and helix blade with a uniform thickness.

Bell Spends $10,000,000 Yearly on Directories

New York City—The Bell Telephone system publishes almost 25,000,000 copies of about 2,000 different directories each year at an annual cost of more than $10,000,000. The paper used weighs about 60,629,000 pounds and represents an annual cost of $2,440,000. To haul this paper from the mills would require 20 solid trains of 50 cars each.

Pittsburgh, Pa.—A new catalog of "Hubbard Pole Line Hardware for Telephone Construction" has been issued by Hubbard & Co. of Pittsburgh. A copy of this interesting and helpful publication will be sent free on request.

CEDAR POLES

Quick Delivery

Prices and Quality Satisfactory "Producer Direc to Consumer"

J. J. SEGUIN

Seguin Bldg., 421 St. Paul St.
QUEBEC CITY, P. Q., CAN.

J.K. Johnston, Telephone Engineer

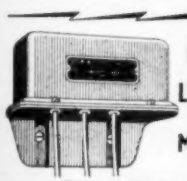
During recent years I have been privileged to appraise Telephone Exchanges all over the United States. The list totals 520. Would you like to avail yourself of my services?

903-4 Lemcke Building, INDIANAPOLIS

ACCOUNTING

Specialization on Public Utility Accounting Records and Audits enables us to best serve Telephone Companies.

HERDRICH AND BOGGS
Certified Public Accountants
1014 Merchants Bank Bldg., Indianapolis, Ind



CHAPMAN
LIGHTNING ARRESTERS
MADE BY
MINNESOTA ELECTRIC CO.
MINNEAPOLIS, MINN.

as low as $18.00 at Chicago

Addressograph

CHEAPER than typewriter—SAVES 20% of YOUR present costs—5 to 15 times FASTER and BETTER than pen or typewriter.

FREE TRIAL will prove it.

904 W. Van Buren St., Chicago, Ill.

Rate Cases Valuations

Charles W. McKay
FINANCIAL REPORTS
448 Wrigley Building Chicago
Phone Superior 3016

RECONSTRUCTED EQUIPMENT

Western Elec. No. 1317, 2 or 3 bar, 1000, 1600 or 2500 ohm Bdg. compacts @..	$ 8.25
Note: The above Western Elec. sets are all equipped with No. 250 Trans., No. 143 Rec., No. 13 Ind. Coil, No. 22 Gen., etc.	
Kellogg 10-line capacity Cordless P.B.X. Swbds., with 7 to 8 local lines and 2 trunks equipped @.....	$75.00
Kellogg No. 301 type combine line drops and jacks, per strip of 5 @...	7.50
Calculagraphs, Swbd. type, @.....	45.00
Kellogg No. 28 desk set with New Rebuilt 5-bar, 1600 ohm concealed wiring signal sets @.....	12.00
Stromberg or Garford 800 ohm line peanut relays @.....	.60
Kellogg No. 118 C. B. desk set with No. 140 steel signal set equipped with No. 79 Booster Ckt. Ind. Coil and Straight line or 16-33-50 or 66 Cycle harmonic ringers @.....	7.25
Stromberg No. 1130 type C. B. Steel hotel sets with straight line ringer and Booster Ind. talking Ckt. @....	6.00
Kellogg 16-33-50 or 66 cycle harmonic ringers with gongs @.....	1.25

Write for our Bulletin
REBUILT ELECTRIC EQUIPMENT CO. Not Inc.
1940 W. 21st St., Chicago

Make Your Directory a Source of Income
Write for Particulars
J. H. WELKER
McKinley Block, Canton, O.
Telephone 8009
DIRECTORY ADVERTISING EXCLUSIVELY

Get your
Telephone Repair Work
done at the old reliable
Telephone Repair Shop
SUTTLE EQUIPMENT CO.
LAWRENCEVILLE, ILL.

UNIVERSAL CYLINDER BELLOWS

keep the switchboards and other telephone apparatus free from dust and dirt. One stroke produces a powerful current of compressed air that removes all dust and dirt beyond the reach of a rag. Carried in stock by dealers in telephone supplies, or write direct for literature and prices.

P. PEIFFER
80 LIBERTY STREET
NEWARK, N. J.

CROSS ARMS

Fir—Yellow Pine
Plain or Treated
LOCUST PINS, OAK BRACKETS, ETC.
All cross arms manufactured and shipped from Baltimore, Md.
GULF CROSS ARM CO.,
Fairfield, P. O. Baltimore, Md.

COFFEY'S
Central Accounting Department

Keeps the records and makes up all reports for companies (large and small) in 17 states. The cost is about half the salary of a bookkeeper. It will not cost you anything to inquire as to our plan, charges, etc. Write today.
Coffey System & Audit Co., Indianapolis, Ind.

J. G. WRAY & CO.
Telephone Engineers

Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.

J. G. Wray, Fellow A. I. E. E.
Cyrus G. Hill
1217 First National Bank Bldg., Chicago

SCRAP PLATINUM

Highest prices paid for discarded or obsolete telephone and switchboard apparatus; platinum contact relays, ring keys, etc. Have specialized in this field for many years.

CONTACT METALS CO.
2500 S. Wabash Ave., Chicago

Send for free sample and prices on
UNIVERSAL DROP WIRE INSULATORS
Universal Specialty Company
129-A, S. 7th St., Terre Haute, Ind.

"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.

SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.

Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.

BARGAIN BULLETIN NO. 75 FREE
Address "REBUILT" EQUIPMENT DEPARTMENT
Premier Electric Company 1800-4 Grace St. Chicago, Ill.

THEIR QUALITY HAS MADE THEM SO:

"ALWAYS RELIABLE"

TORCHES AND FURNACES

Covered by patents
No. 57—Qt.
No. 58—Pt.

One of the leading lines on the market today.

Each torch and furnace is **fully guaranteed.**

Most jobbers stock. Others will order.

Otto Bernz Co. Inc., Newark, N. J.
Stocks in Newark, N. J., New York City, Chicago, and San Francisco
Offices in Newark, N. J., New York City, Chicago, Fort Worth, Denver, Helena, Mont., San Francisco, Los Angeles, Seattle, and St. Thomas, Ont.

STANDARD

Telephone Wires and Cables

include a complete line of rubber and paper insulated, braided and lead covered wires and cables of superior quality.

Complete information on request.

Standard Underground Cable Co.

Boston New York Philadelphia
Washington Pittsburgh Chicago
Detroit St. Louis San Francisco

Two in One

Trouble Finder
Portable Telephone

It simplifies line maintenance
Simple to operate and convenient to use.

Saves time, worry and many hardships

Locates trouble after dark
Eliminates wire cutting in testing

Provides the quickest way of locating line trouble.
Saves service revenue and avoids delays

It will pay for itself in a short time.

Full information furnished on request

The West Manufacturing Co.

447 Monadnock Block Chicago, U. S. A.

SUPERIOR TAPES

Black and Gray Friction

Highest in Quality

Black and Gray Rubber

Meets All Specifications

VICTOR
Telephone Batteries

LINE HARDWARE
HOT GALVANIZED
American Steel & Wire Co.'s Perfected Extra Galvanized
B B. Iron Wire and Steel Strands
Fir Cross Arms—Pins—Brackets—Cedar Poles
Bare and Insulated Copper and Iron Wires

A. J. JOHNSON COMPANY
TELEPHONE SUPPLIES
217 No. Desplaines Street CHICAGO, ILL.

Note Protection at Corners

Blake Insulated Staples

Unequalled for telephone and bell wiring. The fiber insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for samples.

Blake Signal & Mfg. Co.

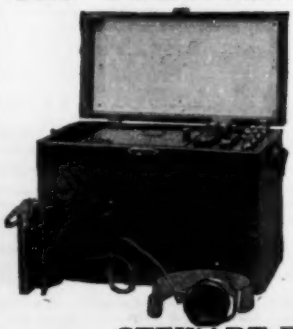
BOSTON, MASS.

Exide
BATTERIES

They do the job for which they were purchased, unfailingly, continually and economically. That, in a nut shell, is the reason Exide Batteries are so extensively used by the large telephone systems of the country.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia
In Canada, Exide Batteries of Canada, Ltd., Toronto

The "STEWART" Cable Tester



Locates shorts, crosses, grounds and wet spots to an inch. Will often save its cost on one case of cable trouble.

Order a "STEWART" Cable Tester and be sure you are going to locate your next case of cable trouble quickly.

Any telephone man can use it. Not an instrument that only an expert can use.

Equipped with two vibrators and an indicating lamp. Write for circular.

Sent on 10 days' trial.

Also, Test Sets, Test Cabinets and Detecto-Meters.

STEWART BROTHERS
OTTAWA, ILLINOIS

Get EVER-PROTECT aid in your construction.

EVER-PROTECT has proved practical and profitable in making many hundreds of cable installations underground without a conduit. It protects cable against storm damage, corrosion, chemical action, electrolysis and abrasion.

In liquid form EVER-PROTECT is great for overhead work, protecting your cable and messengers against chemical action and other destructive influences.

Ask your nearest jobber for complete details.

EVER-PROTECT
CABLE COMPOUND
TRADE MARK REG. U.S. PAT. OFF.

National Cable Compound Co.
Incorporated
MITCHELL - - IND.